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The Great Basin Naturalist

VOLUME XVII, 1957

Editor: Vasco M. Tanner
Assistant Editor: Stephen L. Wood
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Published at Provo, Utah by
Brigham Young University

APR 2 3 1958
UNIVERSITY

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published by

DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY
BRIGHAM YOUNG UNIVERSITY

The Great Basin Naturalist

A journal published from one to four times a year by the Department of Zoology and Entomology, Brigham Young University, Provo, Utah.

Manuscripts: Only original unpublished manuscripts, pertaining to the Great Basin and the Western United States in the main, will be accepted. Manuscripts are subject to the approval of the editor.

Illustrations: All illustrations should be made with a view to having them appear within limits of the printed page. The illustrations that form a part of an article should accompany the manuscript. All half-tones or zinc etchings to appear in this journal are to be made under the supervision of the editor, and the cost of the cuts is to be borne by the contributor.

Reprints: No reprints are furnished free of charge. A price list for reprints and an order form is sent with the proof.

Subscriptions: The annual subscription is $2.50, (outside the United States $3.25). Single number, 80 cents.

All correspondence dealing with manuscripts, subscriptions, reprints and other business matters should be addressed to the Editor, Vasco M. Tanner, Great Basin Naturalist, Brigham Young University, Provo, Utah.

Reprints Schedule of The Great Basin Naturalist

	2 pp.	4 pp.	6 pp.	8 pp.	10 pp.	12 pp.	Each Additional 2 pp.
50 copies	$3.25	$4.75	$5.75	$6.75	$7.75	$8.75	$1.50
100 copies	4.75	5.75	6.75	7.75	8.75	9.75	
200 copies	6.00	7.00	8.00	9.00	10.00	11.00	
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The Great Basin Naturalist

Published by the
Department of Zoology and Entomology
Brigham Young University, Provo, Utah

Volume XVII JULY 31, 1957 Nos. 1-2

NEW POECILANTHRAX, WITH NOTES ON DESCRIBED SPECIES (DIPTERA: BOMBYLIDAE)

D. Elmer[1] and Lucile Maughan Johnson

In his Notes on Osten Sacken's Group Poecilanthrax, Cole[2] reviewed most of the previous work on this genus and described several new species and varieties. A number of these forms were figured, and some of Osten Sacken's illustrations were also included. He did not, however, construct a key. Apparently having at hand representatives of all the forms described from North America, as well as a number of forms we consider to be undescribed, we present below descriptions of most of the latter, notes on some of the species heretofore described, as well as an analytical table which we hope will be useful to others in the identification of species.

Our study of the genus has indicated the urgent need for much more collecting of long series from all parts of the country. The present study is, of necessity, limited to our own collection, to those specimens from other miscellaneous collections that have passed through our hands during the past several years, and to a few specimens loaned to us by the United States National Museum. In all we have examined between seven and eight hundred specimens, mostly from the Middle and Far Western United States, but including a few from Mexico and Canada.

The minor differences between forms, though consistent, are often subtle and difficult to describe, and in some instances require close familiarity with the group to be apparent. In a few instances the intra-specific variation is greater than the usual inter-specific variation.

Of the characters we have used for the differentiation of species one of the most useful has been the venation of the medial area of the wing, particularly the courses of the medial cross-vein and the second medial vein, with the resultant effect on the shape of the discal cell. The presence or absence of an appendiculate spur on the medial cross-vein, though not entirely constant within a species, has, nevertheless, been very useful. The color pattern of the wing has, within fairly narrow limits, been constant in most species. Ground

1. Assistant Entomologist, Ecological Research, University of Utah, Dugway, Utah.
2. Cole, F. R., Notes on Osten Sacken's Group Poecilanthrax, with descriptions of new species. Jour. New York Ent. Soc. Vol. XXV, pp. 67-80, 5 plates, March, 1917

color of legs, antennae, and abdomen has also been useful; however, in some instances, as in the abdomen of *alcyon* and *willistoni* the intra-specific variation has been so great that this character has been rendered almost useless in these species. The color, nature and distribution of the vestiture has been useful; in some instances it has been the most convenient means of differentiation between forms, but its fragility limits its usefulness and wherever possible we have used other more durable characters.

Because of the extreme similarity of some forms, certainly there will be flies that cannot be placed by means of our key, even by one familiar with the group. The accompanying text figures have been prepared with as much care as possible and frequent reference is made to them in an attempt to form a basis for comparison, and to clarify the key as much as possible. All drawings were made with the use of a camera lucida.

We wish here to express our gratitude to the following men and institutions for the loan of material: Illinois State Natural History Survey, United States National Museum, Colorado Agricultural and Mechanical College, Utah State University, Brigham Young University, the Universities of Arizona, Colorado, Idaho, Minnesota and Utah, Dr. D. Geo. Butler, Jr., and Mr. Joe Schuh. We wish also to express gratitude to Drs. Willis W. Wirth and Paul H. Arnaud, United States Department of Agriculture, for their efforts in our behalf in making comparisons with types in the U. S. National Museum.

Except where otherwise noted types of the species herein described are in our collection, presently located at the Brigham Young University, Provo, Utah.

Table of Species

1. Wings distinctly mottled hyaline or subhyaline and brown or black, at least in area of discal cell; veins in posterodistal half usually more or less distinctly bordered with brown. (Figs. 3, 4, 7-12, 14-22) 9

   Anteroproximal half of wings brown, posterodistal half hyaline or subhyaline; wings evenly brown; or wings with color gradually evanescent from anteroproximal to posterodistal, with at most faint borders of darker along veins, but without distinct mottling in the discal cell area. (Figs. 1, 2, 5, 6, 13) 2

2. Anteroproximal half of wing almost evenly brown, posterodistal half evenly subhyaline. (Fig. 2) 3

   Wings not as above 4

3. No black hairs in lateral fringe of abdominal segments anterior to sixth; very few if any black hairs and very little or no black tomentum on hind margins of tergites ..... *sackenii sackenii* (Coq.)

   Black hairs in lateral fringe usually of most abdominal segments anterior to sixth; distinct fasciae of black pile and tomentum on hind margins of most or all tergites after the first (Fig. 2). ..... *sackenii monticola,* n. sub-sp.

4. Wings evenly brown, only slightly paler behind (Fig 6). 5

   Wings definitely darker along anteroproximal portion 6

5. Abdomen with distinct fasciae of black pile and tomentum along hind margins of segments caudad of the first; black pile in lateral fringe of at least two or three abdominal segments, relatively slender species ..... *lucifer* (Fab.)
   Abdomen without fasciae of black pile and tomentum, relatively more robust species (Fig. 6) ..... *tegminipennis* (Say)
6. Medial cross-vein not angled near distal third or fourth, regularly without short spur extending into cell $2M_2$, color of wings and general appearance blackish gray; legs mostly black; first joint of antennae, only, yellow (Fig. 1) ..... *painteri* Maughan
   Medial cross-vein angled near distal third or fourth, usually with a spur extending into $2M_2$ or at least a thickening of the vein at this point; wing color and general appearance usually brownish 7
7. Abdomen without red on sides; second and third antennal segments black; tarsi and most of tibiae black ..... *flaviceps* (Lw.)
   Sides of at least second abdominal segment with spots of red; tibiae mostly red 8
8. To the naked eye discal cell appears to be paler than rest of posterodistal half of wing; third antennal segment very long-conical, the bulbous base not well defined; lateral fringe markedly tufted with black pile, a band of black pile and tomentum across hind margins of all abdominal segments after the first (Fig. 5). ..... *fuliginosa* (Lw.)
   To the naked eye the discal cell concolorous with rest of posterodistal portion of wing; hind angles of abdominal segments well defined; black pile and tomentum usually confined to hind margins of second and third abdominal segments or less (Fig. 13.) ..... *pilosa* (Coq.)
9. Regularly cell R_4 divided into two by a supernumerary cross-vein connecting veins R_4 and R_5 (Fig. 18). 10
   Regularly without cell R_4 divided by a supernumerary cross-vein 11
10. Sides of abdomen narrowly red; wings blackish brown ..... *alpha alpha* (O.S.)
    Sides of abdomen broadly red; wings more reddish brown (Fig. 18). ..... *alpha zionensis*, n. sub-sp.
11. Wings normally with supernumerary cross-vein in cell $2M_2$ connecting vein $M_3 + Cu_1$ to the medial cross-vein (Figs. 4, 16, 20). 12
    Wings normally without supernumerary cross-vein and extra cell 14
12. No free stump of vein projecting into cell $2M_2$; sides of abdomen broadly red; Mid-western and Western species (Figs. 4, 23c). ..... *arethusa* (O.S.)
    Free stump of vein projecting into cell $2M_2$; abdomen usually more narrowly red at sides 13
13. Free stump of vein which projects into cell $2M_2$ is attached to medial cross-vein between attachment of supernumerary cross-vein and vein M_2 (Figs. 16, 23a) ..... *alcyon* (Say)
    Free stump of vein projecting into cell $2M_2$ is attached to supernumerary cross-vein (Figs. 20, 23b). ..... *nigripennis* (Cole)
14. Dark of wings grayish black; at least fore femora dark basally; pile of middle of face black; at most, spots of red on sides of second and third segments (Fig. 21). ..... *californicus* (Cole)
    Dark of wings reddish brown 15
15. Abdomen broadly red at sides 16
    At most, sides of abdomen narrowly red, usually all black or at most small spots on sides of second to fourth segments 22

16. Expanded tip of R_1, R_5 and M_1 wholly brown, without indications of subhyaline spots; first and fifth radial and the cubital veins bordered with yellow; spots in cells $1M_2$ and $2M_2$ and at apex of R_4 completely hyaline (Fig. 3). ..... *effrena* (Coq.)
Wings not as above 17
17. Wings very dark, mottled brown, without completely hyaline areas; abdomen relatively narrowly red at sides; pile and tomentum orange and black; femora with many dark scales; large to very large species (Fig. 17) ..... *ingens*, n. sp.
Wings paler, femora with few, if any, dark scales 18
18. Color pattern at apex of wing obscure, not sharply contrasting hyaline or subhylaine and brown; tomentum and pile of abdomen mostly orange (Fig. 19) ..... *marmoreus*, n. sp.
Color pattern at apex of wing distinct, contrasting brown and hyaline or subhyaline; tufts of black pile on lateral margins of abdominal segments 19
19. Subhyaline spot near basal third of anal and in base of axillary cells; dark brown clouds around all cross-veins and bifurcations of veins; an interrupted fascia of black or dark brown scales at apical third of abdominal segments two to four or five (Fig. 11). ..... *poecilogaster* (O.S.)
Wings without subhyaline spot at basal third of anal and in base of axillary cells; if black or dark brown tomentum is present on abdominal dorsum, it is confined to hind margins of segments 20
20. Axillary cell mostly subhyaline; hyaline window of discal cell area extends uninterrupted to hind margin of wing; vein $M_3 + Cu_1$ not bordered with brown; subhyaline spot in cell 2M large, prominent; pale tomentum of abdomen mostly grayish yellow ..... *willistoni autummalis* (Cole)
Little, if any, subhyaline in axillary cell; subhyaline spot in cell 2M small, obscure; vein $M_3 + Cu_1$ usually broadly bordered with brown 21
21. Fascia of black pile and tomentum present along hind margins of abdominal segments two to five; dark ground color follows both apex and base of segments outward to or nearly to sides of segments (Fig. 7). ..... *signatipennis* (Cole)
Without fasciae of black pile and tomentum on abdomen; dark ground color in form of inverted, truncated pyramids, hind margins of segments narrowly red or light brown (Fig. 14). ..... *marginatus*, n. sp.
22. Legs wholly devoid of black tomentum; posterodistal portion of wings distinctly marked hyaline and brown; vein R_4 broadly bordered with brown; axillary cell mostly hyaline or sub-hyaline (Fig. 8). ..... *willistoni willistoni* (Coq.)
At least some black scales on anterior sides of femora 23
23. Dark brown species, halteres reddish brown; pile of face and front wholly black; tomentum of abdomen dark orange (Fig. 22). ..... *ceyx* (Lw.)
At least pile of sides of face pale; halteres yellow or yellowish brown. 24
24. Fore femora brown to black basally 25
Fore femora wholly yellow or red 26
25. Robust species; distal third of cell R_5 subhyaline; vein M_1 not or very narrowly bordered with brown (Fig. 9). ..... *robustus*, *n. sp.*
More slender species; cell R_5 wholly brown; vein M_1 broadly bordered with brown; fasciae of black pile and tomentum on hind margins of abdominal segments two to five or six (Fig. 15). ..... *fasciatus*, n. sp.

26. Trochanters black (Fig. 10). ..... *butleri*, n. sp.
Trochanters mostly or wholy yellow or red (Fig. 12). .....
..... *colei*, n. sp.

Poecilanthrax alcyon (Say)

Figs. 16, 25a

Next to *willistoni*, we have examined more specimens of this species than of any other in the genus. Considerable variation was observed in the amount of red in the ground color of the abdominal dorsum. In the most broadly red specimens the black occupied no more than about the middle third of the segments, while in the extremes in the other direction there were small spots of red on the sides of the second and third segments only. The usual specimens had red on the sides of all segments, with this color representing perhaps a third or a fourth of the total width of the abdomen. Specimens from the Far West usually had somewhat more red than those from the Middle West.

The extra cell in the medial section of the wing in this species is formed by a supernumerary cross-vein joining the distal angle of the medial cross-vein to vein M_3+Cu_1 (Fig. 23 a). In a few of the specimens this cross-vein was entirely absent or reduced to a short spur in one wing. In two of the specimens examined it was entirely absent from both wings.

An adventitious spur of varying length, attached to the medial cross-vein, protrudes into the distal portion of the second medial cell. Its attachment is usually midway between the attachment of the supernumerary cross-vein and that of the medial cross-vein to the second medial vein, but in some specimens is nearer the former attachment, or coincides with it. It varies in length from little more than a thickening of the vein to about half the length of the supernumerary cross-vein.

The color pattern of the wing varies to some extent, particularly in the intensity of the brown. In some wings the brown is almost without mottling, while in others there are areas of marked lighter and darker color, particularly at the bifurcations of the veins. There is also some variation in the amount of brown.

In general, this species, *arethusa* (O. S.), and *nigripennis* (Cole) are much alike. The body and wing coloring of the darker specimens of *alcyon* are much like those of *nigripennis;* that of the paler, more broadly red specimens much like those of *arethusa*. Among the three the wing venation is the best means of separation we have noted (Fig. 23), and in none of these forms is this absolutely constant. We have seen specimens of all three groups which tend to intergrade into the others. Our material in *arethusa* and *nigripennis* is too limited to pass final judgment, but it may well be that the three are variants of the same species. So far among the specimens available to us we have noted no overlap of range, but here again we are hampered by lack of material.

Poecilanthrax alpha zionensis, n. sub-sp.
Fig. 18

Similar to *Poecilanthrax alpha* (O. S.) but differs in having the abdomen broadly red on the sides. Length 11-14 mm.

Male: Most of front, face, and oral margin yellow; vertex and occiput black, thinly grayish pollinose. Pile of antennae, front, and middle of face black, that of sides of face and occiput pale yellow, tomentum of occiput nearly white. First antennal segment pale yellow; second segment brownish yellow; third segment dark brown. Third segment relatively short-conical basally, the basal bulb being about one-third as long as the slender portion. Proboscis dark brown, projecting less than the length of the labellae beyond the epistoma; palpi yellow, about one-third as long as proboscis.

Thorax dark brown, pleura with some red, thinly gray pollinose. Bristles, pile of collar, tufts of pile before and below wing golden; that of rest of pleura and tuft above each wing nearly white; that of disk of mesonotum short, sparse, black. Scutellum red, narrowly black basally; marginal bristles golden; remaining pile and tomentum appears to be pale yellow on hind margin and sides and black in middle and basally.

Legs mostly red, fore coxae basally, fore and middle trochanters and last four segments of tarsi brownish. Bristles of legs black, most of fine short pile and tomentum pale reddish yellow, a few dark brown to black scales on fore sides of femora and tibiae.

Wings (Fig. 18) subhyaline and dark blackish-brown, the pattern not sharply defined but all veins beyond the r-m cross-vein so broadly bordered with brown that with the exception of the discal cell there are only paler areas in the broader parts of the cells. Supernumerary cross-vein connecting R_1 and R_5, dividing cell R_1 into two parts, discal cell relativesly broad, the medial cross-vein being sharply angled before its union with M_2 and having a stump of a vein at the angle extending into $2M_2$. Veins dark brown, basicostal pile black and tomentum mixed black and yellow. Halteres brownish-yellow.

Abdomen black medially, broadly red on the sides, the black color following the margins of the segments outwards toward the sides. Pile of first segment yellow on sides, mixed yellow and black in middle; rest of pile and tomentum of abdominal dorsum and lateral fringes mostly black, a narrow fascia of sparse pale yellow pile and tomentum across forward third to half of each segment after the second, each fascia being interrupted in the middle by black pile and tomentum. Venter redish yellow; vestiture mostly pale yellow, a few black hairs along middle of hind margins of segments posterior to the third Genitalia red, mostly black haired.

Holotype (male): Zion National Park, Utah, July 8, 1932 (D E. Johnson). *Paratypes*: 1 ♂ same data as type, 3 ♂ same locality (Vasco M. Tanner). The holotype and one paratype are in our collection, the last three specimens are in the collection of the Brigham Young University.

The specimens of this series are remarkably alike in appearance. There is a little variation in the amount of paler color in the wing, and there is a little variation in the width of the black of the abdomen, ranging from about one-fifth to about one-third of the total width of the abdominal dorsum.

Poecilanthrax butleri, n. sp.

Figs. 10, 25b

Brown species, abdomen with red spots on sides of anterior segments, usually two and three, but sometimes only two and occasionally two to four. Wings with distinct markings, vein R_3 not or very narrowly bordered with brown. Length 11-16 mm.

Male: Front to ocellar tubercle, face and oral margin yellow; vertex brown, yellowish brown pollinose; occiput black, cinereus pollinose. Pile of front black, a few yellow hairs on orbits opposite antennae, pile of occiput and sides of face yellow, black on and above epistoma, sparse tomentum above antennae shining yellow. First antennal segment yellow, pile black above, yellow beneath; second and third segments black, pile of second short, black; third segment relatively short-conical (Fig. 25b). Proboscis black; palpi yellow, brownish basally, about one-fifth as long as proboscis.

Thorax brown, thinly brown pollinose on mesonotum, cinereus pollinose on pleura; except for short, sparse, black pile of mesonotum, vestiture of thorax pale yellow. Scutellum black, brownish-red in middle and apically; a patch of black, hairlike tomentum mesobasally, rest of vestiture yellow.

Legs red, coxae, trochanters, knees, and tarsi mostly dark brown. Pile of coxae yellow, of femora short, sparse, black. Tomentum of legs mostly yellow, a few black scales on forward sides of femora, scales of insides of tibiae mostly black.

Wings (Fig. 10) brown and subhyaline, the brown of anteroproximal portion mostly yellowish; posterodistal portion blackish brown, distal half of discal cell and cells R_3 and R_1 mostly subhyaline, vein R_1 not or hardly bordered with brown, rest of posterodistal part of wing dark gray subhyaline, the veins broadly, indefinitely bordered with diffuse brown. Veins mostly dark brown. Halteres pale brown, knobs paler.

Abdomen mostly dark brown, faintly grayish pollinose, large spots of red on sides of second and third and smaller one on sides of fourth segments. Pile of abdomen short, sparse, yellow, a few black hairs on hind angles and on hind margins of segments two to seven; tomentum sparse, yellow, a narrow fascia of dark scales on hind margin of segment two, a few dark scales on middle of hind margins of third to fifth. These black scales are bordered along extreme hind margin by a row of yellow ones. Venter cinereus pollinose, second and third sternites brown basally, with red hind margins, fourth to seventh sternites red basally with black hind margins. Vestiture

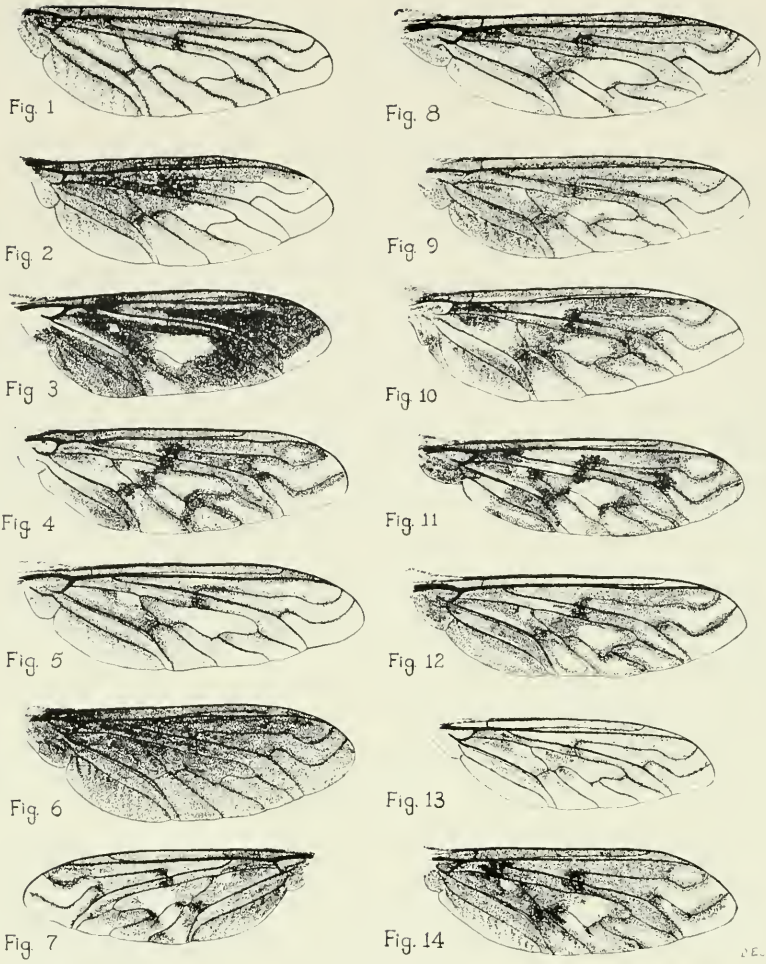

PLATE I

Fig. 1.—*Poecilanthrax painteri* Maughan: wing of male paratype.
Fig. 2.—*P. sackeni monticola*, n. sub-sp.: wing of holotype.
Fig. 3.—*P. effrena* (Coq.): wing of Arizona specimen.
Fig. 4.—*P. arethusa* (O.S.): wing of Arizona specimen.
Fig. 5.—*P. fuliginosa* (Lw.): wing of Arizona specimen.
Fig. 6.—*P. tegminipennis* (Say): wing of Minnesota specimen.
Fig. 7.—*P. signatipennis* (Cole): wing of Yelowstone Park paratype.
Fig. 8.—*P. willistoni* (Coq.): wing of California cotype.
Fig. 9.—*P. robustus*, n. sp.: wing of holotype.
Fig. 10.—*P. butleri*, n. sp.: wing of holotype.
Fig. 11.—*P. poecilogaster* (O.S.): wing of Arizona specimen.
Fig. 12.—*P. colei*, n. sp.: wing of holotype.
Fig. 13.—*P. pilosa* (Cole): wing of paratype.
Fig. 14.—*P. marginatus*, n. sp.: wings of holotype.

nearly white. Genitalia brown, pile mixed black and pale yellow.

Female: Very much like the male. Somewhat more tomentose. Abdominal dorsum usually with less red. First four sternites largely reddish, last three largely black; a fringe of black hairs on hind margin of seventh sternite.

Holotype (male): Tucson, Arizona, October 15, 1955 (F. G. Werner), on *Baccharia sarothoides*. *Allotype* (female): Tucson, Arizona, October 14, 1955 (G. D. Butler, Jr.), on *Baccharia*. *Paratypes:* Arizona: 1 ♀ Buckeye (T. D. A. Cockerell), 1 ♀ Ehrenberg, September 10, 1938 (F. H. Parker), 1 ♀ Roll, July 19, 1954 (G. D. Butler), 1 ♂ Sunnyslope, May 26 (Butler), 1 ♂ Phoenix, 6 ♂ 4 ♀ Tucson, March 25, April 18, May 9, October 14-17 (G. D. Butler, F. G. Werner); New Mexico: 1 ♀ Las Cruces, September 20; Wyoming: 1 ♀ Wyo. (Morrison). In addition to the above many specimens have been returned to the University of Arizona. The types and part of the paratypes are in our collection. The rest of the paratypes are in the collections of the Universities of Arizona and Minnesota and the U. S. National Museum.

In addition to the variation in size there is some variation in the amount of red in the ground color of the abdomen. In some specimens of both sexes the red on the sides is confined to the second segment, while in the other extreme there is some red on even the fourth segment. Ventrally the variation runs from almost wholly red to almost wholly black, but most of the specimens of both sexes are marked more or less like the types. There is some small variation in the amount of black tomentum on the abdominal dorsum and sides. The extreme in one direction is an almost total lack of black tomentum, while in the darker specimens there are some black scales on all segments. But again in this character most of the specimens studied are like the types. One or two specimens have a very short stump of vein extending into the cell $2M_2$. In some specimens the apex of the first antennal segment is brown.

This species appears to be most closely related to *colei* from which it may be separated by the much sparser pile and tomentum of the abdomen, by the longer, more conical third antennal segment, by the black second antennal segment, by the nearly black coxae and trochanters, by the much narrower discal cell (Fig. 10), and by the paler fifth radial and first anal cells. Also, in this species the black tomentum on the abdominal terga is bordered along the hind margins by a row of yellow scales whereas in *colei* no such border exists.

Poecilanthrax californicus (Cole)

Fig. 21

Though the sex was not specified, Cole apparently described this species from a male specimen, since among the females studied two have very small red spots on the sides of the second tergite only and the others have none at all. The venters of most of them are broadly

red on the first segment, with or without narrowly red hind margins on the succeeding one or two segments.

Cole noted that his specimens from Nevada and New Mexico were darker than his California specimens. His Reno, Nevada specimen listed is a female, and shows the usually darker aspect of that sex. However, the specimens of both sexes we have studied from Arizona, Nevada, New Mexico and Utah are somewhat darker generally, have more definite wing pattern, and have less red on the abdominal venter than the California types and the California material in our collection. In most of the males from the more eastern part of their range the first three sternites are red on the sides and narrowly to broadly black in the middle. Oregon specimens are more nearly like the California material.

In most of the well preserved specimens of both sexes the black tomentum and pile on the hind margins of the tergites are wider in or limited to the middle of each segment after the second, becoming progressively narrower caudad, giving the appearance of a row of ill-defined spots down the center of the abdomen. In the middle of the seventh tergite are usually a few brownish hairs and scales. The pile of the face is usually black in the middle and nearly white on the sides. Specimens in our collection range in length from 11 to 16 millimeters.

Poecilanthrax colei, n. sp.
Figs. 12, 25a

Wings marked subhyaline and brown, pattern definite. Discal cell broad, medial cross-vein sharply angulate at its distal fourth, short stump of vein extends into cell $2M_2$. Length 13-16 mm.

Male: Front, face and oral margin yellow, occiput and vertex dark brown pollinose, lower occiput cinereus pollinose. Pile of upper half and middle of lower half of front black, that of sides of lower half of front and face yellow, a few black hairs mixed with the yellow on the epistoma. Sparse, scattered hairlike tomentum of lower front pale yellow. Pile and tomentum of occiput pale yellow. First two segments of antennae yellow, third black. Pile on upper sides of first two segments black, on lower sides yellow. Proboscis dark brown, projecting about half the length of the labellae beyond the epistoma. Palpi pale yellow, about two-fifths as long as the proboscis.

Mesonotum brown, brown pollinose, pleura brown and yellow, cinereus pollinose. Long pile and bristles of thorax and sparse hairlike tomentum yellow; short pile of mesonotum black. Scutellum red, its base and sides narrowly black; bristles, pile and tomentum mostly yellow, a patch of black pile and tomentum basally.

Legs yellow, tips of tarsi, base of fore coxae, and spots on trochanters brown. Long pile and most of tomentum pale yellow, short pile and bristles black, a few dark scales beneath on the hind femora and middle and third tibiae.

Wings (Fig. 12) brown and nearly pure hyaline, pattern well

defined; anteroproximal portion, R_5 and 1 A solid brown, rest of cells in posterodistal portion of wing with veins broadly bordered with brown, middles of these cells hyaline. Wing margin in cells R_3 and R_4 not bordered with brown. Discal cell relatively broad at distal fourth, medial cross-vein sharply angulate at its distal fifth with a short spur extending into cell $2M_2$. Veins brown, somewhat paler basally; pile at base of costa black, tomentum at base of costa brown and yellow. Halteres yellow, knob nearly white.

Abdomen black, faintly bluish-cinereus pollinose, sides of second and third tergites broadly red. Pile of first and most of that of second and third tergites yellow, long and dense on lateral fringe, short and sparse on dorsum; yellow on first and most of second and third tergites and on anterior half of rest of segments; black on hind margins of all segments caudad of the first A facia of black scales along the hind margin of second and a spot in the middle of the hind margin of third, fourth and fifth segments. Rest of tomentum of abdomen yellow, somewhat darker along hind margins of segments. Venter mostly yellow, some dark markings beyond the third sternite; pile and tomentum pale yellow, genitalia brown and yellow. Pile mostly yellow, a few black hairs intermixed.

Female: Much like the male. Somewhat more pilose and tomentose. Spurious vein in cell $2M_2$ somewhat longer than in male. Less red on sides of second and third tergites. Some brown on each of first five sternites. Caudal half of venter almost wholly yellow. A few black hairs along hind margins of sixth and seventh sternites. Genitalia yellow, spines and pile yellow.

Holotype (male): Los Angeles Co., Cal., Sept. (A. Koebele). U. S. National Museum type No. 63510. *Allotype* (female): Cal (Coquillett). U. S. Natonal Museum accession No. 20.326. *Paratypes*: 2 ♀ same data as allotype; 1 ♀ Morgan Hill, Sept. 5, 1939 (C. E. Mickle); 2 ♀ Los Angeles, Cal. (Coquillett); 1 ♀ same data as last two, but bearing an additional label with the numbers $\frac{11}{10}$ and a paratype label No. 20,738 USNM. This last specimen is one of the four used by Cole in his type series of *Anthrax pilosa*. It gives us pleasure to name this species in his honor.

This species differs from *pilosa* (Cole) in having a wider discal cell, more definite wing pattern, and a different tomentum pattern on the abdomen. In *pilosa* where there is dark pile and tomentum across the hind margins of the tergites, this color extends all or most of the way across the width of the segments, while in *colei* it extends the width of the second segment only but is confined to a narrow spot in the middle of the succeeding segments. The means by which this species may be separated from *butleri* are discussed under that species.

Poecilanthrax fasciatus, n. sp.
Figs. 15, 25g

Wings (Fig. 15) with definite color pattern; discal cell relatively broad, stump of vein extending into $2M_2$; pronounced fascia of black

pile and tomentum across hind margins of abdomenal segments. Length 12-14 mm.

Female: Most of front, face and oral margins pale yellow; vertex and occiput black, thinly gray pollinose; pile of antennae, front, and middle of face black, that of sides of face and occiput nearly white. First two antennal segments yellow, the third black; third segment not quite as long as first two combined, moderately short-conical, its bulbous base about as long as the slender portion (Fig. 25g). Proboscis dark brown, projecting but little beyond the epistoma; palpi pale brown, about one-third as long as the proboscis.

Thorax dark brown, some red on pleura; thinly brownish pollinose on mesonotum, more denesly cinereus pollinose on pleura. Pile and bristles of thorax almost uniformly pale yellow, the short tomentum of the mesonotum only slightly darker than the rest. Scutellum red, narrowly black basally; bristles, pile and tomentum mostly pale yellow, a patch of black pile and tomentum in the middle.

Coxae mostly brown, the tips of the fore coxae yellow, about the basal third of fore femora dark brown on forward side, rest of femora and tibiae reddish yellow; tarsi brown, the basitarsi somewhat paler. Pile and tomentum of coxae pale yellow; bristles and fine, short pile of legs black; tomentum pale yellow, except brown on forward sides of middle and hind femora and tibiae.

Wings (Fig. 15) brown and subhyaline, the brown portions being of a nearly uniform color; there is the usual pale spot in the second medial cell; the brown fills all of the wing forward of the first medial vein except the extreme tip of cell R_5, most of R_4, and the ends of R_1 and R_3; vein R_2+_3 is broadly bordered with brown and vein R_4 narrowly so about half of its length. In the posterior portion of the wing brown fills wing to line from r-m cross-vein to end of Cu_2; veins M_1 and M_2 are broadly bordered with brown, cell M_1 being almost completely filled with color; the medial cross-vein is sharply angled just before its union with M_2, and a stump of vein projects from it into $2M_2$. Veins brown, pile and tomentum at base of costa mostly black, a few pale yellow scales behind along vein. Halteres pale brownish-yellow.

Abdomen black, thinly purplish-gray pollinose; spots of red on sides of segments two and three. Pile and tomentum mostly pale yellow, black pile along hind margins and tufts of longer black hairs on hind angles of all segments except first; fascia of black tomentum on hind margins of segments two to five, giving a markedly fasciate appearance of abdomen. Venter mostly red, somewhat irregularly mottled with darker; pile and tomentum pale yellow, a very few black hairs on last two segments. Genitalia dark brown, hairs brown and black.

Holotype (female): Crowley, Colorado, September 2, 1939 (M. T. James). *Paratypes*: 2 ♀ same data as type.

The abdomen of this species closely resembles that of *P. lucifer*, but the mottled wings of this species resembles that of *P. butleri*, but this species has far more pronounced fasciation of the abdomen and less red on the sides of the abdominal segments than that species. Also, *butleri* has a shorter proboscis, brown second antennal segment, sparse yellow tomentum on lower front, and a narrower discal cell, usually without a spur of vein on the medial cross-vein.

Poecilanthrax ingens, n. sp.
Figs. 17, 25c

Large, dark reddish brown species, abdomen broadly red at sides. Pile of front and most of face black. Length 14-20 mm.

Male and *female*: Head yellow, occiput black; vertex and upper occiput thinly brownish pollinose, lower occiput cinereus pollinose. Pile of lower occiput, sides of face, and palpi golden, rest of pile of head black. Tomentum of occiput shining golden. First antennal segment red, from lateral aspect about two and one-half times as long as wide (Fig. 25c); second segment not quite as wide as first, almost round, red; third segment black, short-conical, the styliform portion about two and one-half times as long as first two segments combined. Pile of first segment long, of second short. Proboscis dark brown, labellae projecting beyond the epistoma. Palpi yellow, about one-fourth as long as proboscis.

Thorax black, thinly purplish-brown pollinose. Pile of collar and pleura orange, a few long black hairs on the humeri and intermixed with orange ones on sides of mesonotum above and in front of wings. Short pile of mesonotum and scutellum black; sparse tomentum of mesonotum shining orange, of pleura pale yellow. Two notopleural bristles on each side red, rest of thoracic bristles black. Scutellum dark red, black basally and at sides, tomentum black basally, shining orange apically.

Legs red, fore femora basally, fore tibiae apically, and all tarsi dark brown. Legs mostly black tomentose anteriorly, yellow behind; pile of coxae golden, of legs mostly black, spines black.

Wings (Fig. 17) dark brown, faintly mottled with paler areas in most of the cells, lighter in R, base of R_1, center of $1M_2$, $2M_2$, and Cu_1. Veins reddish-brown basally, darkening distally, costal pile and tomentum black, a few orange scales at extreme base. Squamae small, fringe yellowish-brown. Halteres brown, knobs paler at tips.

Abdomen dark brown, segments two to seven red on sides, the black color having a tendency to follow the base and apex of each segment to, or nearly to its margin. Dorsum thinly reddish-brown to purplish pollinose. Most of pile of first and all on anterior sides of second segment golden orange, of sides of rest of abdomen moderately dense and long, mostly black, a few orange to yellow hairs basally on each segment. Tomentum sparse, black and golden orange, the latter being mostly on the basal half and a narrow apical fringe of the segments. Venter red, pile and tomentum orange.

Genitalia red, pile mixed black and orange, the heavy spines of the female red-brown.

Holotype (male) and *allotype* (female): Ramsey Canyon, Huachuca Mountains, Cochise County, Arizona. September 5, 1955 (F. G. Werner and G. D. Butler). *Paratypes*: 9♂ 2♀ same locality, September 5-7, 1955 (F. G. Warner and G. D. Butler). Part of the paratypes are in the collection of the University of Arizona.

In the wings of some of the specimens the paler areas approach sub-hyaline and are more extensive than in the types. In fact, in one specimen all cells are brownish sub-hyaline and all veins broadly bordered with dark brown. There is a little variation in the proportions and amounts of black and orange pile and tomentum on the abdomen, and also in the width of the red on the lateral margins.

The shape of the third antennal segment (Fig. 25c) will separate this species from its congeners; this antennal segment, in all other species with which we are acquainted, is more tapered. In addition, this species may be separated from *effrena* by the different wing pattern, from *marmoreus* by the presence of more black pile and tomentum on the abodmen, and from both by the black bristles on the thorax. This is the largest and one of the most handsome species we know. The extreme wing-spread of some of the specimens is nearly fifty millimeters.

Poecilanthrax marginatus, n. sp.
Figs. 14, 25f

Brown, abdomen broadly red, hind margins of segments narrowly bordered with red. Wings mostly evenly brown, the sub-hyaline spots in cells 1 and $2M_2$, and R_3 and R_4 distinct. Length 10-14 mm.

Male: Front, face, and lower half of occiput yellow, vertex and upper half of occiput black; brown pollinose on vertex, thinly cinereus pollinose on occiput. Pile of upper front black, of lower front, occiput and face pale yellow, a few black hairs on the epistoma and two or three behind the antennae. Antennae (Fig. 25f) of the usual shape, the first two segments yellow, the third black. Pile of the second segment short, black; of the first segment black above, mostly yellow below. Proboscis black; palpi yellow, nearly half as long as proboscis

Thorax brown, thinly brown pollinose, the plura largely red, gray pollinose. Except for short, sparse black pile on mesonotal disk, pile and bristles of thorax yellow. Tomentum of mesonotum hairlike, moderately sparse, brownish-yellow. Scutellum brownish-red, dark brown basally and on sides; a few black hairs and hairlike scales on central base; rest of vestiture yellow, tinged with reddish brown in center.

Legs yellow, the fore coxae brown basally and on inside, distal segment or two of tarsi brown; tomentum yellow, bristles and short sparse pile black.

Wings (Fig. 19) mostly evenly dark brown, somewhat darker spots in middle of R_1, on r-m cross-vein, and on bases of R_{2+3}, medial cross-vein, and Cu_1; there are sub-hyaline spots near apex of R_3 and R_4, in the middle of $1M_2$, base of $2M_2$, and middle of Cu_1, the latter spot more or less indistinct, the other quite distinct, the ones in first and second M_2 joined. Discal cell broad apically, with a stump of vein extending into $2M_2$ which is about half as long as width of that cell. Halteres pale yellow, the knobs nearly white.

Abdomen mostly red, thinly cinereus pollinose, first segment broadly dark brown basally, segments two to six with broad-based, truncated patches of dark brown, the hind margin of each segment narrowly red. Tomentum yellow, tinged with golden brown in caudal half of dark area of each segment. Pile mostly yellow, abundant on first and sides of second, moderately abundant on sides of rest of segments, sparse on dorsum; tufts of black hairs on hind angles of segments 2-4, two or three rows of short black hairs on hind margins of segments 5-7 and along hind margin of seven. Venter red, somewhat brownish basally; vestiture pale yellow. Genitalia red, hairs golden red.

Female: Like the male. A few more black hairs between the antennae and on the epistoma. Color of tomentum faintly tinged with brown along hind margins of abdominal segments, venter with more brown, abdomen somewhat more densely tomentose than male. Genitalia brownish-red, heavy spines reddish-yellow.

Holotype (male) and *allotype* (female): Johnson's Pass, Tooele County, Utah, September 4, 1955 (D. E. Johnson). *Paratypes*: 2♂ 6♀ same data as types; 2♀ same locality, Sept. 12 (D. E. Johnson); 1♂ 3♀ Little Valley, Sept. 18 (D. E. Johnson). Idaho: Bannock Co., Lava Hot Springs, 1♂, Sept. 21, 1948 (D. E. Johnson); 2♀ Sept 28, 1934 (D. E. Johnson). Iowa: 1♀ Sioux City, (C. N. Ainslie). North Dakota: 1♀ Renville County, Bottineau, Aug. 12, 1920 (C. N. Ainslie). Part of the paratypes are in the collection of the University of Minnesota.

This species may be readily separated from *signatipennis* by the absence of black tomentum on the hind margins of the abodminal segments and by the shape of the dark areas on these segments. In *signatipennis* the black follows the hind margin of each segment outward to the sides of the segment and the hind margin is black, while in *marginatus* the black is truncated and the red follows the hind margin its entire width, giving the species its name.

Johnson's Pass separates the Stansbury and Onaqui Mountains in southeastern Tooele County, Utah. The type specimens were collected a half mile or so south of the Pass summit at an elevation of about 6,800 feet above sea level. The dominant plants are sage brush *(Artemisia tridentata)* and junipers *(Juniperus utahensis)*. At the same time, a number of other species of bee-flies were collected at this site. The most common of these were *Villa alternata* (Say), *Villa lateralis* (Say), *Lordotus gibbus gibbus* Lowe, *L. pulchrissimus pulchrissimus* Williston, *Epacmus litus* Coq., *Poeci-*

lanthrax sackenii (Coq.), *P. willistoni* (Coq.) and *P. signatipennis* (Cole). Also common were two asilids, *Holopogon maculinervis* James and *Promachus nigripes* Hine. At the time of collection these specimens were mistaken for *signatipennis*, which they resemble, and it was not until the following winter, when they were being labeled, that the differences were discovered. Evidently the two species were presnt in about equal numbrs, for of the nineteen specimens collected nine are *signatipennis*. Many more specimens were seen but not collected.

The Idaho locality is very closely comparable to the Utah one, the principal difference being that in Idaho the juniper happened to be *J. scopulorum*, with stands of *J. utahensis* within a short distance. At the Idaho locality we did not happen to find *P. signatipennis* nor *Eclimus litus*, but the other species listed above were present.

Poecilanthrax marmoreus, n. sp.
Figs. 19, 25h

Medium to large species, mostly orange pilose, reddish-brown wings with indistinct patterns. Length 11-18 mm.

Male: Face, front, and under part of head red, occiput and vertex black, thinly cinereus pollinose. Pile of vertex, front, and most of antennae black, rest of pile of head orange, that on epistoma darker; a few hairlike orange scales on front and occiput. First two antennal segments red, a few orange hairs mixed with the black on first segment; third segment, from lateral aspect, moderately long-conical (Fig. 25h). Proboscis brown, hardly projecting beyond the epistoma; palpi pale yellow, about one-third the length of the proboscis, nearly white haired.

Thorax brown, thinly grayish pollinose, pleura mostly red, cinereus pollinose; scutellum red, narrowly black basally. Sparse black pile on mesonotal disk and scutellum, a few black bristles on hind margin and a few black scales on base of scutellum; rest of vestiture of thorax bright orange, the thoracic bristles somewhat darker.

Legs yellowish-red, fore coxae dark brown basally, dense tomentum orange, sparse; short pile and bristles black.

Wings (Fig. 19) reddish-brown, yellowish on anteromedial portion and along veins, indistinctly darker at r-m cross-vein, and indistinctly paler in the discal cell and in $2M_2$ and Cu_1, also faintly mottled in the distal third of the wing. Veins yellowish-brown, cross-veins darker. Halteres grayish-yellow.

Abdomen red, pinkish pollinose, a broad-based truncated pyramid of black on each segment. Pile mostly orange, rows of black hairs on hind margins of segments two to six. Tomentum hairlike, orange, a fascia of black scales across second segment just before the apex, occupying about one-fourth of the segment. A few scattered black scales in the same relative position on segment three. Venter and genitalia red; orange tomentose and pilose.

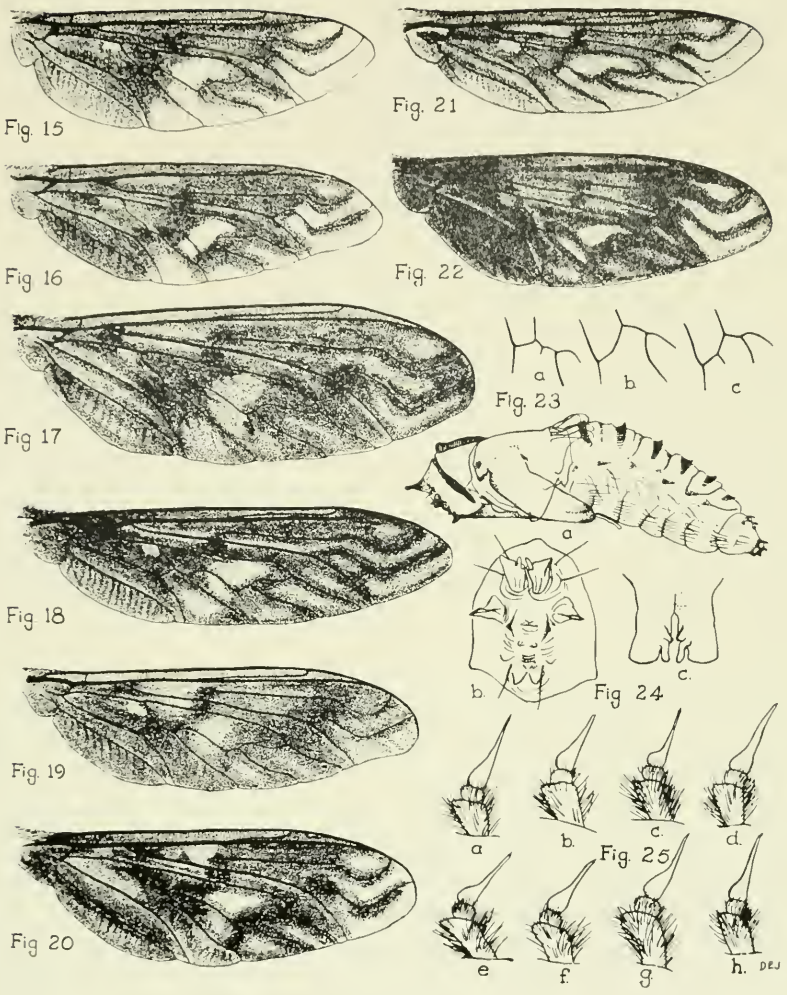

PLATE II

Fig. 15.—*P. fasciatus*, n. sp.: wing of paratype female.
Fig. 16.—*P. alcyon* (Say): wing of Minnesota specimen.
Fig. 17.—*P. ingens*, n. sp.: wing of holotype.
Fig. 18.—*P. alpha zionensis*, n. sub-sp.: wing of holotype.
Fig. 19.—*P. marmoreus*, n. sp.: wing of holotype.
Fig. 20.—*P. nigripennis* (Cole): wing of paratype.
Fig. 21.—*P. californicus* (Cole): wing of California paratype.
Fig. 22.—*P. ceyx* (Lw.): Michigan specimen.
Fig. 23.—Supernumerary vein and spurs in wings of:
a. *P. alcyon* (Say).
b. *P. nigripennis* (Cole).
c. *P. arethusa* (O.S.).

Fig. 24.—Cast pupal skin of *P. willistoni willistoni* (Coq.) reared from the cocoon of an Army cutworm:
a. Lateral aspect.
b. Frontal aspect of head.
c. Dorsal aspect of frontal cephalic tubercles.
Fig. 25.—Dorsal aspect of antennae of:
a. *P. colei,* n. sp., holotype
b. *P. butleri,* n. sp., holotype.
c. *P. ingens,* n. sp., holotype.
d. *P. robustus,* n. sp., holotype.
e. *P. sackenii monticola,* n. sub-sp., holotype.
f. *P. marginatus,* n. sp., holotype.
g. *P. fasciatus,* n. sp., paratype.
h. *P. marmoreus,* n. sp., holotype.

Female: Much like the male. A few black hairs among the orange ones on the epistoma. Tomentum of mesonotum brownish-orange. Basal third of scutellum black. Black ground color of abdomen more extensive than in male and much more black pile on hind margins of segments and in lateral fringe. Seventh segment with mixed black and orange hair apically. Venter with brown markings on most of the segments. Heavy spines of genitalia red.

Holotype (male) and *allotype* (female): Yavapai Point, Grand Canyon, Coconino County, Arizona, August 21, 1944 (L. Schellbach). *Paratypes*: 1♂ North Rim Grand Canyon, Coconino Co., Arizona, August 15, 1942, (H. C. Bryant); 1♂ S. Arizona, August 1902 (F. H. Snow); 8♂ 6♀ Zion National Park, Washington Co., Utah (V. M. Tanner, Angus Woodbury).

The holotype (U. S. National Museum type No. 63,509) and allotype are in the U. S. National Museum. Part of the paratypes are in our collection and part in that of the Brigham Young University.

In addition to the variation in size there is considerable variation in the amount of black pile and tomentum on the abdominal dorsum. The specimen with the least amount of dark colored vestiture is a male having part of the pile on the front orange, only a very few black hairs on the hind margins of segments two to six. The specimen having the greatest amount of dark vestiture is a female having most of the hairs of the face black and much of the pile of the abdomen black, in addition to several rows of black pile on the hind margins of the abdominal segments, and a few black hairs in the lateral fringe. In some specimens the fore coxae are almost wholly dark.

This species may be separated from *effrena* by the lack of clear hyaline areas in the wing, by the orange pile in the lateral fringe, and by the more reddish wing color. It may be separated from *ingens* by the paler wings, by the absence of black hairs in the pleural pile, absence of dark fore femora, and by the smaller amounts of black pile and tomentum on the abdomen. This species averages somewhat smaller than *ingens*, but the largest specimens have nearly as great wing span, one female being forty- five millimeters across.

In her 1935[3] study, the junior writer misidentified this species as *effrena* (Coq.). Among the material in the collection of the Brigham Young University is one specimen that may be a teneral *effrena*, but the other specimens listed in the 1935 paper are this species.

Poecilanthrax painteri Maughan
Fig 1

On the wing much earlier in the season than any of its congeners in its particular range, this species is evidently quite rare. Although avidly sought after, only eleven specimens have come into our collection since its original description in 1935. Three others have been seen alive but were not collected. We have encountered this species as early as May 31 in Tooele County, Utah, and as late as June 30 in Cache County, Utah, and June 27 in Bannock County, Idaho. The Tooele County specimens, one male and one female, were collected in sand dunes in Skull Valley, at an elevation of about 4600 feet above sea level. All other specimens seen and collected have been encounteded in mountainous terrain at elevations above 6000 feet. In all cases sage brush, *Artemisia tridentata*, has been the dominant shrub. In the Skull Valley dunes greasewood, *Sarcobatus vermiculatus*, is perhaps the next most common plant.

Poecilanthrax pilosa (Cole)
Fig. 13

In his type series Cole had four specimens. We have examined three of these, and believe them to represent two distinct species. Of these three, two specimens have wings which are characteriezd by obscure markings and a very narrow discal cell (Fig. 13). The medial cross-vein is somewhat angulate and bears a short spur. The abdominal venter is largely black; there are small spots of red on the sides of the second tergite. In other words, these two specimens fit Cole's description of *Anthrax pilosa*. Dr. Paul Arnaud assures us that the remaining specimen in the U. S. National Museum collection is also marked thus. We believe the type of this species should be limited by designating the specimen in the Museum which bears the type label as the lectotype. Dr. Arnaud has so labelled the specimen. It is a female, bears the type number 20,738, and data labels Los Angeles, Calif., and Collection Coquillett.

The fourth specimen of Cole's series, a male bearing a label U. S. N. M. Paratype No. 20,738, and collection data the same as the type, is a different species, and is described in this paper as *Poecilanthrax colei*, n. sp.

In addition to the above we examined specimens of *pilosa* from California, Idaho, Nevada and Utah. Over its range the species exhibits considerable variation. The specimens from Idaho and Utah

3. Maughan, Lucile, A Systematical and Morphological Study of Utah Bombyliidae, with notes on Species from Intermountain States. Jour. Kans. Ent. Soc., Vol. 8, No. 1-2, pp. 27-80, Jan.-April 1935.

have somewhat less pile than those from California and Nevada, and usually have more red on the abdominal venter. Throughout their range there is variation in color of the fore femora, ranging in color from wholly red to broadly brown basally. There is considerable variation in the amount of black hair in the abdominal lateral fringe, specimens from a single population varying from many black hairs to practically none.

The male of this species usually differs from the female in having somewhat more red on the sides and venter of the abdomen and in being somewhat less pilose and tomentose generally. The differences between this species and *colei* are discussed under that species.

Specimens of this species were misidentified in the junior writer's 1935 paper (loc.cit.) as *Poecilanthrax tegminipennis* (Say).

Poecilanthrax robustus, n. sp.
Figs. 9, 25d

Large, robust species, abdomen mostly gray tomentose, at most red on sides of segments two and three. Vein R_4 faintly or not at all bordered with brown. Length 13-17 mm.

Male: Head black; face, front, and oral margin yellow; thinly brown pollinose at vertex, occiput cinereus pollinose. Pile of front black above, pale yellow on lower fourth, a patch of black hair between antennae. Pile of epistoma and middle of face black, of sides of face nearly white. Pile and tomentum of occiput pale gray. First segment of antennae red, from the lateral aspect about twice as long as wide (Fig. 25d), third segment black, long-conical, about as long as first two combined. Pile of antennae black, a few brownish hairs beneath on first segment; long and dense on first, short on second segments. Proboscis brown, the labellae projecting beyond the epistoma. Palpi yellow, yellow haired, about half as long as proboscis.

Thorax dark brown, thinly grayish-brown pollinose; pleura cinereus pollinose; faint indications of three vittae on mesonotum. Pile of collar yellow, that above wing nearly white, of rest of mesonotum black; a few yellow hairs immediately before the scutellum. Tomentum of mesonotum sparse, pale grayish-yellow; bristles yellow. Pile and tomentum of pleura pale yellow, nearly white below. Scutellum red, broadly black basally, pile and tomentum pale grayish-yellow, a patch of brown scales and black hairs in the middle. Spines pale brownish-yellow.

Legs yellow; fore femora basally, coxae and tarsi brown. Tomedium grayish-yellow, brown scales anteriorly on fore and middle legs. Pile anteriorly on fore and middle femora and on tibiae black; on coxae, hind femora and posteriorly on fore and middle femora nearly white. Spines of legs black.

Wings (Fig. 9) brown and sub-hyaline, the pattern not sharply defined. The base and expanded end of cell R_1, distal three-fifths of R_2, R_4, all but the base of R_5, the distal half of $1M_2$, and most of M_4,

$2M_2$, and Cu_1 subhyaline. Most of the veins faintly bordered with brown, darker at bases of R_4, M_{1+2}, and $M_3 + Cu_1$. A long stump of vein intrudes into cell $2M_2$. Veins dark brown; tomentum at base of costa brown, pile black. Halteres pale brown, the knobs nearly white at tips. Squamal fringe pale brown.

Abdomen dark brown, spots of red on sides of segments two and three. Tomentum of abdomen mostly pale grayish-yellow, brownish on hind margins of segments. A patch of black in the brown on segments two to five, broadest on two and successively narrower. Pile of first and sides of first four segments abundant, nearly white, a few black and brown hairs on hind angles of two to four; on sides of rest of segments mostly black intermixed with white. Sparse pile of dorsum mostly pale brown and pale yellow, a few black hairs on hind margins of segments two to five, many on six and seven. Venter mostly red, densely clothed with nearly white tomentum and long pale yellow pile. Genitalia red, with golden and black hairs.

Female: Much like the male. More robust. Second antennal segment red. More black pile at sides of abdomen, patch of black tomentum in middle of scutellum. Bases of sternites three and four and all of five to seven black; genitalia brown, pile golden, heavy spines red.

Holotype (male) and *allotype* (female): Walker's Pass, Kern County, California. September 29, 1945 (D. E. Johnson). *Paratypes*: 8 ♀, same locality, September 16-30, 1945 (D. E. Johnson).

Aside from the difference in size this series of flies is remarkably alike. Two specimens have red on sides of segment three, as in the male, and in some the dark tomentum of the hind margin on the second tergite is mostly black. In some specimens the pile in the center of the face is mixed black and brown.

This species may be separated from *willistoni*, to which it is closely related, by the lack of sharply defined brown borders along the veins in the posterodistal part of the wing, by the row of spots of dark tomentum on the abdominal dorsum, and by the generally less red on the sides of the abdomen.

These specimens were collected, along with many other species of bee-flies, near a well in the botton of the canyon some distance from the top of the Pass on the Great Basin side. The abundant growth of *Chrysothamnus* was in full bloom. The specimens were collected at the bloom and on the damp ground near the well, where they appeared to be drinking.

Poecilanthrax sackenii sackenii (Coquillett)

Although described by Coquillett as only a variety of *tegminipennis* (Say), we consider *sackenii* to be sufficiently distinct from that species to be accorded full specific rank. We have studied specimens of *tegminipennis* from the Mid-west only and specimens of *sackenii* from the Far West only. It may well be that a study of the

populations between these widely separted areas will disclose a relationship that we have not seen.

In his "Notes on Type Specimens" Painter (1939) reported that Coquillett's type could not be located and apparently is lost. In a list of the types in their collection furnished by the U. S. National Museum *Anthrax tegminipennis sackenii* Coquillett is not listed, confirming Painter's statement. Because of this and the fact that Coquillett's description is very inadequate, we are giving here a more complete description of the insect which we believe to be this species.

Male: Front, face, and oral margin pale yellow, vertex and occiput black, cinereus pollinose; pile of most of front and middle of lower face black, of sides of face and lower sides of front pale yellow; a few pale yellow hairlike scales on lower front and hind orbits. First antennal segment yellow, second and third black, pile black. Proboscis black, not or hardly projecting beyond the episoma; palpi brown, about one-third the length of the proboscis.

Thorax black; short sparse pile of mesonotum black, rest of vestiture of thorax pale yellow. Scutellum black, a dark reddish brown spot in the middle; a patch of black-like tomentum in middle basally, rest of vestiture pale yellow.

Legs red, coxae, trochanters, tarsi, and basal half of fore femora dark brown. Tomentum mostly fulvous, a few black scales on anterior sides of femora and at knees. Pile of coxae yellow, bristles and short pile of legs black.

Wings evenly brown on anteroproximal half, posterodistal half subhyaline, only faintly marked with lighter and darker areas. Discal cell narrow, usually without stump of vein on medial crossvein. Veins yellowish brown basally, darker apically. Pile and most of tomentum at base of costa black, a few yellow scales behind, along the vein. Halteres yellowish-brown, tip of knob ivory.

Abdomen black, faintly bluish pollinose. Pile of lateral fringe dense, on dorsum sparse, very pale yellow, a fringe of black hairs along hind margin of seventh segment. Most of tomentum pale yellow, a few black scales in middle on hind margins of segments two, three and four. Venter black, vestiture pale yellow. Genitalia black, hairs black and brown.

Female: Like the male in most respects. Somewhat more tomentose. Tomentum of central hind margins of abdominal segments tinged with brownish, but usually without black scales. Hind margin of seventh sternite fringed with black hairs. Heavy spines of genitalia red.

The above descriptions are drawn from specimens in our collection collected at Johnson's Pass, Tooele County, Utah, September 3-4, 1955. Specimens in our collection range in length from eleven to sixteen millimeters. There is some variation in the amount of black pile and tomentum on the abdomen. In most of the females we have studied there is little or no black tomentum on the abdominal dorsum. In most of the males there are at least a few black scales on

the hind margins of at least the second segment. But in both sexes there are exceptions. In one series of specimens from the Great Salt Lake Desert none of the males have any black scales on the abdominal dorsum. In some males there is a fringe of black pile on the hind margin of the seventh sternite. Some specimens of both sexes have a few black hairs in the lateral fringe and/or across the hind margins of the last two or three segments. Some specimens have a few yellow hairs on the lower side of the first antennal segment. Some, particularly females, have the second antennal segment varying shades of brown.

We have seen specimens from California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington and Wyoming in the United States, and from the province of Alberta in Canada.

Poecilanthrax sackenii monticola, n. sub-sp.
Figs. 2, 25e

Similar to *P. sackenii* (Coq.) but differs in having more narrow fasciae of black tomentum on hind margins of at least second and in having tufts of black pile on hind angles of most abdominal segments in both sexes. Length 11-13 mm.

Male: Most of front, face and oral margin yellow; vertex and occiput dark brown, faintly grayish pollinose. First antennal segment yellow; second and third black; third segment short-conical basally, the bulbous base being about half as long as slender portion (Fig. 25e). Pile of antennae, front, and middle of face black, with a prominent tuft of hairs on epitoma; that of sides of face pale golden, of occiput nearly white; a few shining pale golden hairlike scales on lower half of front; tomentum of occiput pale yellow. Proboscis black, not at all projecting; palpi nearly half as long as proboscis, dark brown.

Thorax dark brown, thinly grayish-brown pollinose on mesonotum which is in some lights iridescent, more densely gray pollinose on pleura. Short fine pile of mesonotum black; rest of pile, tomentum, and bristles of thorax yellow. Scutellum black, a dark red spot in the middle. Bristles, pile, and tomentum yellow, a patch of black pile and tomentum basally.

Coxae brown, their tips paler; trochanters black; fore femora except apically, and tarsi dark brown; rest of femora and tibiae reddish-yellow, and fore tibiae brownish apically. Pile and tomentum of coxae pale yellow; spines and most of fine pile of rest of legs black; most of tomentum of legs yellow, black scales on anterior sides of femora and tibiae.

Wings (Fig. 2) evenly brown and sub-hyaline, the brown extending in a diffuse, irregular line from near the end of R_1 to the base of Cu_1. Veins brown, somewhat darker apically. Halteres pale yellow.

Abdomen wholly dark brown, thinly brownish pollinose; a narrow fascia of black tomentum on hind margins of segments two, three and four, which does not reach sides of abdomen; a row of black

hairs along hind margins of segments two to seven, moderately dense on six and seven, sparse on others; tufts of black hairs on hind angles of all segments caudad of second; rest of vestiture of abdomen pale yellow. Genitalia brown.

Female: Much like the male. Not quite as many black hairs in lateral fringe as in male, nor as much black tomentum on abdominal dorsum. Knob of halteres is darker on lower side.

Holotype (male): Emerald Lake, Utah County, Utah, July 23, 1955 (D. E. Johnson). *Allotype* (female): Same locality, August 4, (D. E. Johnson). *Paratypes*: Idaho, Bannock Co., 2♂ 1♀, Pebble Basin, July 24, 1948 (D. E. Johnson). Utah, 4♀, same data as allotype.

This form is darker in general appearance than typical *sackenii* and is somewhat smaller in average size—more so than the extremes listed above would indicate. Records in our files indicate that this form is on the wing somewhat earlier in the season than *sackenii*.

The type locality is the immediate vicinity of Emerald Lake, a small glacial lake on the back of Mt. Timpanogos, Utah County, Utah, at an elevation of about 11,000 feet above sea level. Other beeflies we have found at the Lake include *Villa wilcoxi* Painter, *V. fulviana nigricauda* (Lw.) and a species of *Pantarbes* which will be described in a forthcoming paper. The Idaho specimens were collected at about 8,500 feet.

Poecilanthrax signatipennis (Cole)
Fig. 7

Cole pointed out that his Nevada specimens differed somewhat from his Wyoming type. Specimens in our collection from California and Oregon are like Cole's Nevada paratypes, which we have examined. Those from Colorado, Montana, Utah and Wyoming are like the Yellowstone Park type (Fig. 7). In the wing the areas of subhyaline are less opaque, and the veins R_{2+3} and R_1 are more broadly bordered with brown in the California, Nevada and Oregon specimens. The more eastern specimens appear to have somewhat more black pile and tomentum on the hind margins and somewhat less red on the sides of the abdominal segments. There is perhaps enough difference in the two forms to justify the separation of a sub-species, but our material is too limited to be certain.

Poecilanthrax willistoni willistoni (Coquillett)
Figs. 8, 24

Of all the specimens of this genus studied, collected, or observed in the field, this has been by far the most commonly encountered species. We have examined specimens from Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. We have studied long series from widely separated localities and have compared many with cotypes borrowed from the U. S. National Museum.

Among the many specimens studied we found that some characters have remained relatively constant, while others have shown considerable variation. Perhaps the most constant character has been the wing pattern (Fig. 8). Even the extremes that have come to our attention have not deviated very far, and this character has served as a convenient means of ready identification.

We found very few adventitious stumps and cross-veins and the variation in the amount and distribution of color in the posterodistal portion of the wing has been small. In the color of the fore femora there was a variation from almost wholly red to nearly a third of the femora being dark brown. In the amount of dark tomentum on the abdominal dorsum the variation was from practically no dark scales to narrow fasciae on most of the segments. The amount of red on the lateral margins of the abdominal segments was perhaps the most widely variable character studied. Most specimens examined were marked about alike, but in nearly any given local poulation, in addition to specimens of the usual pattern there are some marked very narrowly with red and some others in which the red occupied most of the dorsum, leaving only narrow dark markings in the centers of the segments. The usual specimen may be described as follows:

Male and *female*: Face, front, and lower half of occiput yellow, vertex and upper half of occiput black, thinly cinereus pollinose. Pile of upper front, first two antennal segments, and anterior oral margin mostly black; rest of pile of head pale yellow. First two antennal segments yellow, third black. Proboscis brown, not projecting beyond the epistoma; palpi yellow, nearly half as long as proboscis.

Thorax brown, thinly gray pollinose, pleura with considerable red, pile, tomentum and bristles yellow; scutellum red except narrowly at base, pile, tomentum and bristles yellow, a patch of black hairs and hairlike tomentum in the middle.

Legs red, tarsi, bases of fore femora and tips of fore tibae brown; tomentum pale grayish yellow, sparse pile and bristles black.

Wings sub-hyaline and brown (Fig. 8), the markings distinct; most of first and second M_2 and Cu_1, most of M_1 and R_4, the apical half of R_3, and about half of 2A cells hyaline or sub-hyaline, the medial cross-vein and $M_3 + Cu_1$ not or hardly bordered with brown, but R_{2+3} and R_4 broadly bordered with brown. There is also a fairly large sub-hyaline spot in 2M. Halteres yellow, the knobs somewhat paler.

Abdomen brown, the sides of segments two to five, sides and apex of six, and all of seven red, the red spots on sides of segments two and three much wider than those on four and five. Tomentum mostly tan, a narrow fascia of black scales across second segment just before its apex, a spot of similar black scales in middle of segment three, scales of hind margins of all segments somewhat tinged with brownish; the tomentum of segments six and seven nearly white. Pile of first and sides of second pale yellow; of lateral margins

of rest of abdomen yellow and black, the latter forming tufts on hind angles of segments. A row of sparse short black pile along hind margins of segments, rest of sparse pile of dorsum pale grayish yellow. Venter red, the segments broadly black basaly; sparse vestiture nearly white.

This description was prepared from one of Coquillett's cotypes in the U. S. National Museum. It represents the form most usually encountered.

Poecilanthrax willistoni autumnalis (Cole), n. comb.

Comparison of the California material in our collection with one of Cole's specimens of *Anthrax arethusa autumnalis* and with part of Coquillett's type series of *A. willistoni* convinces us that this is the correct association for Cole's sub-species. The only consistent difference we note between series of *autumnalis* and typical *willistoni* is in the extent of the red ground color of the abdomen. Typical *willistoni* specimens are narrowly red on the sides of the abdominal segments, and have more or less black on the venter. *Autumnalis* is only narrowly black down the middle of the abdominal dorsum, and almost wholly red ventrally. In a number of long series of specimens of *willistoni* the individual variation has been as great as the difference between *willistoni* and *autumnalis*. However, all of the specimens collected in the California areas that produced the *autumnalis* type were consistently of the broadly red abdomen, while in those areas that produced the *willistoni* type only occasional specimens were broadly red. Until further information is available, therefore, we consider *autumnalis* (Cole) to be a sub-species of *willistoni* (Coq.).

A NEW CAECULUS FROM OREGON

(Acarina: Caeculidae)

Harold G. Higgins[1] and Stanley B. Mulaik[1]

In 1954, Mulaik and Allred described a species of the genus *Caeculus* taken from moss at Oak Ridge, Oregon. This mite, *C. oregonus*, was the first species of this genus known to occur in that state. While collecting mites near Meacham, Oregon, the wife of the senior author found an undescribed species of this genus under conifers. The holotype will be deposited in the Acarina collection at the University of Utah. This brings to 19 the number of species known for the United States.

Caeculus mariae, n. sp.

Diagnosis—Propodosomal plate projects anteriorly over the gnathosoma; metapodosomal plate with nine setae arranged in a 3-3-3 sequence; the left and right metapodosomal plates each have five setae arranged in groups with a slitlike stigmata after setae two and four; trochanter I with two setae; the inner seta is curved and situated on a tubercle nearly as long as the seta, the second seta is nearly straight and located dorsally near the center of the trochanter.

Description—The length of the body is .90 mm. Width of the body at the fourth pair of legs is .60 mm. The propodosomal plate projects anteriorly over the gnathosomal tubercles and has four setae along each side. Two of these setae are located on each side of the propodosomal plate near the level of the eyes; the third seta, and the smallest of the propodosomal setae, is located near the anterior edge of trochanter I; while the fourth seta which is quite spatulated is located on a tubercle on the anterior edge of the plate. The metapodosomal plate has nine setae arranged in 3-3-3 order. Both the left and right metapodosomal plates have five setae, the first four of which are grouped in pairs with a slit-like stigmata between each group. The anterior transverse opisthosomal plate has four setae in a fairly straight row. There are seven setae in an irregular row on the posterior opisthosomal plate.

Leg I is composed of seven segments, slightly longer than leg IV, but shorter than the body. Trochanter I has one long curved, fluted seta located on a tubercle on the inner edge, and one straight, fluted seta located dorsally. The tubercle on the inner edge of this trochanter is nearly as long as its seta. Basifemur and telofemur I each have a long seta on their inner edge. The seta on telofemur I is approximately twice as large as the seta on basifemur I. Genu I has two large tubercles on the inner edge, but unfortunately the spines are missing. Tibia I has three dagger-shaped spines on the inner edge of which the anterior ones are the longest. Tarsus I has four short, sharp spines on the inner edge. Trochanter III has two setae on the anterior edge and one seta located dorsally.

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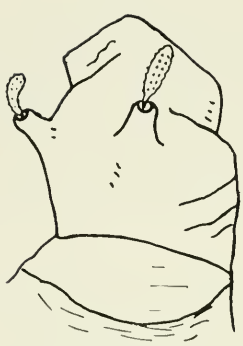

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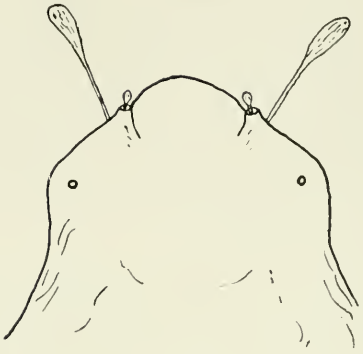

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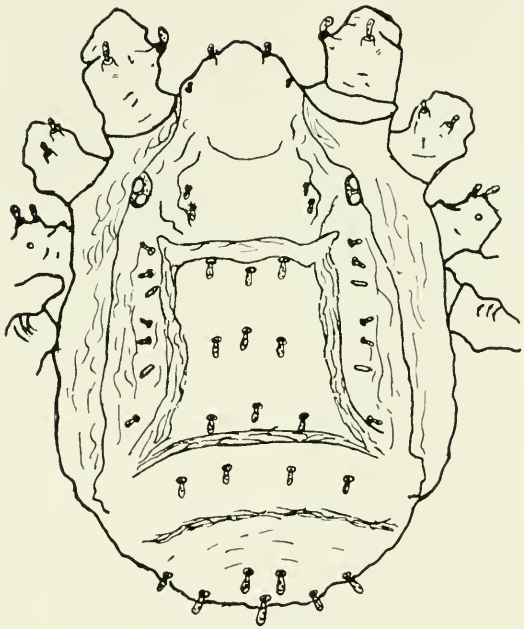

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Fig. 1. Dorsal view of right trochanter I.
Fig. 2. Dorsal view of anterior end of propodosoma.
Fig. 3. *Caeculus mariae,* dorsal view.

Discussion—Caeculus mariae differs from *C. oregonus* in that the propodosomal plate projects anteriorly over the gnathosoma, and by the number and arrangement of the setae on trochanter I. This

new species also differs from *C. calechius* Mulaik and *C. archeri* Mulaik, the other species of this genus possessing two setae on trochanter I, by the much longer tubercle on the inner margin of trochanter I and by the arrangement and number of the dorsal setae.

Type—The holotype, collected from needles and debris under conifers near Meacham, Oregon, August 19, 1956, by Marie Higgins, is in the collection of the Department of Zoology, University of Utah.

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AN ALBINO SWALLOW IN UTAH

D. Elmer Johnson[1]

On Saturday, August 4, 1956, while fishing on the Provo River just below the Deer Creek Dam, Wasatch County, Utah, a white bird was observed flying with a flock of swallows. The birds were some distance from the observer, and though the flight of the white bird was characteristically that of a swallow, identification was uncertain. Some few minutes later, however, the birds moved into a meadow near the river to feed on the numerous insects flying there. The swallows, of which there were many, proved to be mostly violet-greens, *Tachycineta thalassina lepida* Mearns; with a few tree swallows, *Iridoprocne bicolor* (Vieillot); and an occasional rough-wing, *Steligdopterix ruficollis serripennis* (Audubon) intermixed. They remained in the meadow as long as they were under observation.

The white swallow was under close observation for about fifteen minutes, as it skimmed the river surface or darted about the meadow after food. During the course of its feeding it repeatedly came within less than ten feet of the observer, both above and below eye-level, making it possible to see all aspects of its body at fairly close range. The color of the beak, eyes and feet could not be determined with certainty, but not a colored feather of any kind could be seen. The shape of the wings and tail, the relatively short, blunt body profile, and the manner of flight appeared to the observer to be more characteristic of the violet-green than of the slightly longer-tailed, more slender rough-wing and tree swallows.

On Tuesday, August 7, 1956, the spot was revisited with the hope of being able to collect this interesting albino and thereby making certain of its identity. But though many swallows were feeding in the meadow and many others were resting on the branches of nearby trees and on telephone wires, the white bird was not seen.

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SCOLOPENDRID CHILOPODS OF THE NORTHERN ANDES REGION TAKEN ON THE CALIFORNIA ACADEMY SOUTH AMERICA EPEDITION OF 1954-1955

Ralph V. Chamberlin[1]

In continuation northward of the field work done by the California Academy of Sciences Expedition in Chili and Peru in 1950-'51, an expedition from the same institution carried on work in the Andes in Peru, Ecuador and Colombia. Of the chilopods secured on this second expedition, all collected by Dr. Edward S. Ross and E. I. Schlinger, I am here privileged to report upon the Scolopendrida.

Order SCOLOPENDRIDA

Scolopendridae

Scolopendra gigantea weyrauchi Bücherl

Location — *Peru*: 4 mi. W. of Ontario, La Liberad. One specimen, January 15, 1955.

Cormocephalus ungulatus (Meinert)

Localities — *Ecuador*: Pungo, one, Jan. 9, 1955; 6 mi. W. of Santo Domingo de los Colorados, two, February 23, 1955. *Peru*: Yurso, 67 mi. E. of Tingo Maria, one specimen on each of the following dates: Oct. 19, Nov. 10, and Dec. 18, 1954; Loma Lachay, 16 mi. W. of Chancay, Lima, one, Sept. 11, 1954.

All of these specimens agree with *ungulatus* in the more distinctive features while varying among themselves especially in the number of spinules on the prefemur of the legs. Most specimens are not fully grown.

Cormocephalus (Cupipes) anechinus, n. sp.

Color olive green throughout. Length 44 mm.

Head wider than long (11:10), the sides very convex; with paired sulci diverging forward to about middle. Basal plate exposed at ends. Antennae reaching upon second tergite, composed of 17 segments of which the first two are wholly glabrous, the third and fourth with hairs sparse, and the others completely clothed.

Prosternal plate bearing 3-3 or 4-4 teeth of which the inner two, or to some extent three, are fused together, the ectal tooth standing apart.

Dorsal plates from the first to the twentieth with complete paired sulci, the seventeenth to twenty-first margined, margining on the fifteenth and sixteenth evident only over middle of length, the twenty-first tergite with a fine median longitudinal sulcus.

Sternites 2 to 20 with deep paired sulci.

Last sternite narrowing caudad, strongly rounded posteriorly,

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not sulcate. Last coxae with well developed pore area, not at all produced caudally, bearing two spinules at mesoventral corner.

Anal legs with prefemur, femur and tibia strongly inflated, flattened above, the femur and prefemur conspicuously furrowed above. All joints wholly lacking spinules. Claw very long, of *Cupipes* type.

Localities — *Peru*: 48 km. E. of Carhuamayo, Junin, many specimens taken Dec. 30, 1954; 37 km. E. of Carhuamayo, Junin, five specimens taken Sept. 15, 1954.

Differing from *C. andinus* (Kraepelin) in having no caudal process on the coxopleurae and from this species and *C. impressus* in lacking spinules on the anal legs as well as in the dentition of the prosternal plates.

Cormocephalus (Cupipes) tingonus, n. sp.

Length, 40 mm.

Head equal in length and breadth, the sides but slightly convex over posterior portion, nearly parallel; surface smooth, almost wholly devoid of punctae; fine paired sulci diverging forward to middle length. Antennae composed of 17 articles of which the first two are glabrous.

Prosternal plate bearing 4-4 teeth. Prosternum with two sulci meeting at an angle at the anterior margin, diverging caudad.

Paramedian sulci complete beginning on tergite 1. Two last dorsal plates with a median longitudinal sulcus. Only the twenty-first tergite definitely margined.

Last ventral plate narrowing caudad, its caudal margin straight. Coxopleura with poriferous area not reaching caudal margin; not produced caudad, the rounded mesocaudal corner bearing two denticles.

Sternites with paired sulci across anterior border of second plate but these complete beginning with third plate.

Anal leg with prefemur, femur and tibia crassate and flattened above as usual, a longitudinal furrow on the first two of these joints. Prefumur with two spinules at distomesal angle above; ventrally typically four widely separated spinules, two toward inner side and two near outer, with rarely a single submedian spinule at base, on dorsomesal edge near middle one spinule. Femur without spinules. Claw of usual large size in the group.

Locality — *Peru*: Monson Valley, Tingo Maria, one taken Dec. 18, 1954.

Differing from *ungulatus* in having no ventral spine on the prefemur on its caudal margin other than the two at the dorsal angle and no spinules in the middle ventral face; also in having the diverging sulci of the prosternum extending over three fourths of the length of the plate instead of only one third the length, etc.

Otostigmidae

Otostigmus burgeri monsonus, n. subsp.

Color olive throughout. Length, 57-58 mm.

Antennae long, composed of 18-21 mostly long articles of which the first three are naked. Prosternal teeth 4-4.

Tarsi of legs 2 to 18 with two tarsal spines, leg 19 with only the ventral spine, leg 20 with none.

Paired sulci on tergites 4 to 19, partially indicated also on 3. Surface of tergites smooth throughout; sharply margined from the fourth on. Last tergite with a shallow longitudinal furrow which is deeper toward caudal end.

Anal coxopleurae extended caudad in a low conical process bearing two spinules at its tip. Anal legs long and slender.

Locality — *Peru*: Monson Valley, Tingo Maria, two taken Dec. 9, 1954.

Because *burgeri* is incompletely known, the present Peruvian form is separated with some doubt. It seems best, however, to designate it as a subspecies because of the following apparent differences: paired dorsal sulci beginning on tergite 4, or incomplete also on 3; tarsi of legs of first pair with a single spine instead of two; and tarsi of legs 18 and 19 with two spinules instead of only one.

Otostigmus (Parotostigmus) lavanus, n. sp.

Color olive green throughout. Length 52 mm.

Articles of antennae 17, of which the first 2 1/5 are glabrous.

Prosternal teeth 4 - 4; of these the two innermost on each side are fused together at base. Prosternum without a sulcus.

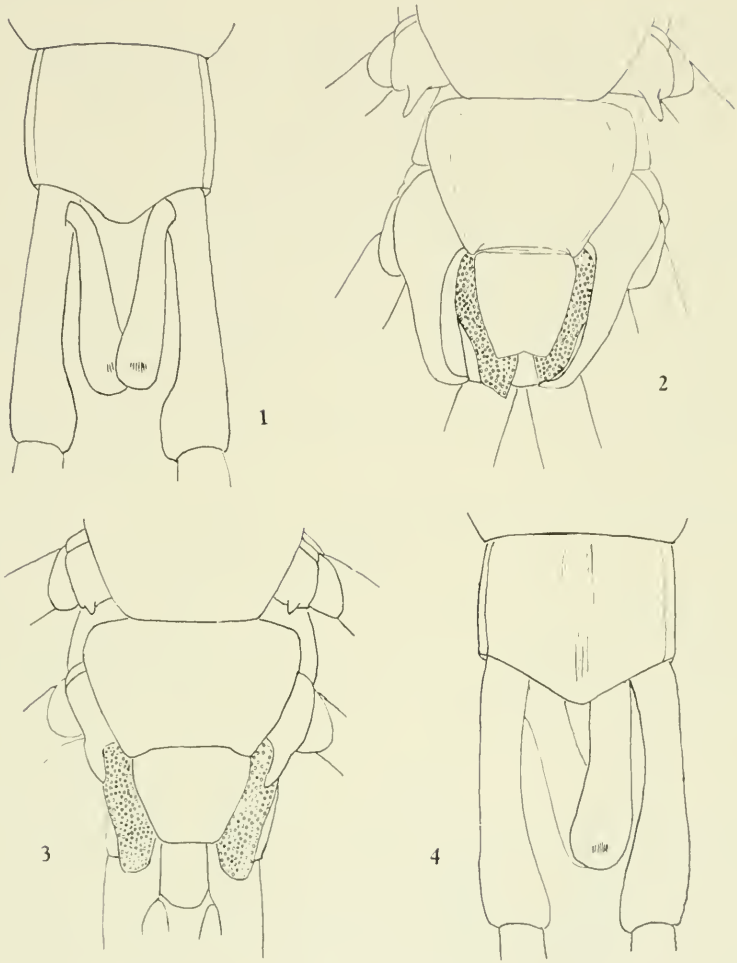
Paired sulci complete beginning with the sixth tergite. Posterior tergites with fine scabrous points over surface, these more numerous on the last tergite, and posterior plates roughened on the sides but without true ridges or keels, a median ridge, however, being obscurely indicated on a few of the last plates. Last tergite with a shallow, median longitudinal furrow which is not sharply impressed. Only the last tergite truly margined.

Sternites without sulci, but some showing a shallow median depression.

A single tarsal spine, which is ventral, on leg 1 to 19, the legs of the twentieth pair without this spine.

Last ventral plate strongly narrowed caudad, the caudal margin incurved or forming an obtuse reentrant angle, the plate without a median sulcus (Fig. 1). Coxae with mesocaudal corner but not produced and bearing no spinules.

In the male the anal legs have the prefemur bearing an elongate appendage which is three fourths or more the length of the joint, and presenting on dorsal side toward distal end a small patch of golden colored hair. Coxae of the twentieth legs with a conspicuous process, curved distally and extending a little beyond the last sternite as



Otostigmus lavanus: Fig. 1, Caudal end of male, dorsal view; Fig. 2, The same, ventral view. *Otostigmus mesethus*: Fig. 3, Caudal end of male, ventral view; Fig. 4, The same dorsal view.

shown in figure (Fig. 2). The coxae of the nineteenth legs with a smaller process.

Locality — *Ecuador*: 6-12 mi. SW. of Banos, N. slope of Mt. Tungu-

One male taken Feb. 13, 1955.

This form differs from *O. insignis* in lacking a sharply defined median keel on the posterior tergites, in lacking a median sulcus on the last sternite, and in the male having coxal processes on the nineteenth legs and in having the coxal process of the twentieth legs much shorter and in a longer prefemoral appendage. The processes of the

coxae of the twentieth legs are longer than those in *O. silvestri*.

Otastigmus (Parotostigmus) mesethus, n. sp.

Olive green, the legs lighter. Length 45 mm.

In general structure close to *O. lavanus*. It differs in having two tarsal spines on the first three pairs of legs instead of but one, in having the caudal margin of the last sternite straight, at least in the male, or but slightly incurved in the female, and in having the mesocaudal corner of the last coxae rounded instead of angular.

A conspicuous difference in the male is in the much shorter, simply conical coxal process of the twentieth legs as shown in figure 3. Unfortunately the lack of an adequate series makes it impossible to draw any conclusions as to range of variation in this character that might be correlated with age. The appendage of the anal legs in the male is proportionately shorter as shown in figure 3.

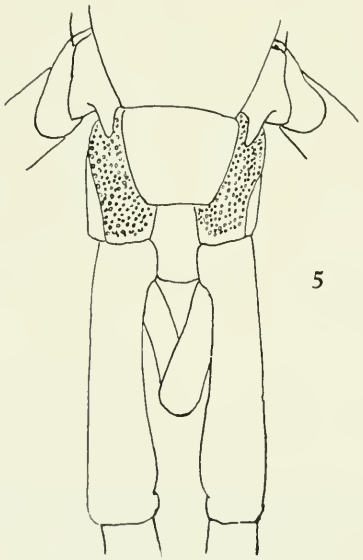
Locality — *Ecuador*: 6-12 mi. SW of Banos. N. slope of Mt. Tungurahua.

Male and female taken February 13, 1955.

Otostigmus (Parotostigmus) parvior, n. sp.

Length, 40 mm.

In the spining of the legs and other major features close to *mesethus*, but separated primarily on the basis of differences in the secondary sexual characters of the male. In the present form the



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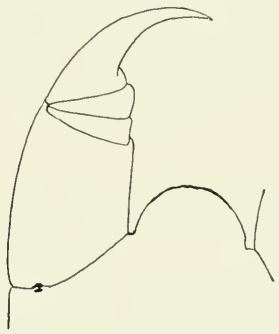


6

Otostigmus parvior: Fig. 5, Caudal end of male, ventral view. *Newportia ecuadorana*: Fig. 6, Right prehensor and anterior portion of prosternum.

coxal process of the twentieth legs is much smaller, no coxal process is present on the nineteenth legs, and the appendage of the prefemur of the anal legs is much shorter. The caudal margin of the last sternite straight.

Locality — *Equador*: 20 mi. SE of Ambabo. Male holotype and female allotype taken Feb. 8, 1955.

Cryptopidae

Cryptops rossi Chamberlin

Locality — *Ecuador*: Banos, Tunguraha. One specimen taken Feb. 11, 1955.

This specimen presents the unusual color pattern of the types which were taken in Colombia at Buena Ventura.

Cryptops calinus, n. sp.

Body yellowish, with the head and caudal end, including the anal legs, chestnut.

Length, 11 mm. First tergite a little overlapping the head.

Antennae composed of 14 articles. Head with two fine short sulci across posterior border. Prosternal margin nearly straight, slightly obtusely indented at middle.

First tergite without sulci. Paramedian sulci complete, beginning on segment 5.

Spiracles all circular.

Sternites typically with a median longitudinal furrow and a transverse furrow crossing it at the middle.

Last ventral plate wide, broadly rounded behind. Coxal pores extending to caudal margin of the joint.

Legs sparsely clothed with setae. The twentieth legs on the joints proximad of the tarsus with an area or pad of dense fine hairs.

Anal legs with sparse hairs on dorsal surface, these hairs more abundant on distal joints than on femur and prefemur. None of the joints with terminal teeth; prefemur beneath with numerous short, conical pointed spinules, with fewer of the same above, a naked area between the patches of spinules on both ectal and mesal surface; femur with similar spinules beneath and a band of them on dorsomesal surface above a naked area; tibia beneath with five teeth in series, the first tarsus with two.

Locality — *Colombia*: 11 mi. W. of Cali, Valle. Two specimens taken March 23, 1955.

This species is like the African *C. philammus* in having the first tergite overlapping the head, complete paired sulci beginning on tergite 5 and in the ventral areas of fine hair on the twentieth legs. It differs in having the spiracles all circular instead of elliptic and in the more slender prefemur and femur of the anal legs, with the prefemur also differing in having naked areas on ectal and mesal faces between the patches of spinules.

Dinocryptopidae

Otocryptops ferrugineus (Linne)

Localities — *Peru*: 37 mi. E. of Carhuamayo, one, Sept. 15, 1954; 4 mi. W. of Otusco, La Libertad, one, Jan. 15, 1955; 43 mi. E. of Tingo Maria, Nov. 18, 1954. *Ecuador*: 45 mi. E. of Alausi, at 3,000 m., Feb. 24, 1955; 30 mi. S. of Alausi, Feb. 20, 1955; Tixan, 8 mi. NE of Alausi, Feb. 14, 1955; 8 mi. N. of Alausi, Chimborazo, also Feb. 14, 1955.

Dinocryptops miersii (Newport)

Localities — *Peru*: 40 mi. E. of Tingo Maria, one taken Dec. 12, 1955; 37 mi. E. of Carhuamayo, one, Sept. 15, 1955; 48 mi. S. of Carhuamayo, one, Dec. 30, 1954; 4 mi. W. of Otusco, La Libertad, one, Jan. 15, 1955. *Ecuador*: 28 mi. S. of Quito, one Feb. 22, 1955; 30 mi. S. of Alausi, Chimborazo, two, Feb. 20, 1955; Tixan, 8 mi. N. of Alausi, Chimborazo, several, Feb. 14, 1955.

Newportia albana, n. sp.

Color more or less chestnut throughout. Length, about 20 mm. Head with fine paired sulci posteriorly. Articles of antennae 17.

First tergite with curved transverse sulcus which is not at all angled at the middle; two paired longitudinal sulci which continue forward in front of the transverse one.

Paramedian paired sulci on tergites beginning with the fifth or sixth. Surface of tergites smooth, none with a median keel. Last tergite with caudal margin of median lobe nearly straight.

Tarsi of anterior legs uniarticulate, tibia of these legs with ventral and dorsal spine.

Last ventral plate strongly narrowed caudad, the posterior margin convex. Area of coxal pores reaching caudal margin of the joint; coxal process especially short, each with a denticle or spinous point toward base on ectodorsal face.

Anal legs with prefemur bearing five spines beneath, all smaller than usual, with the most anterior especially reduced; the aborted spinules in dorsal series few. Femur with two small spines in the same longitudinal line on the proximal half of the ventral face. Tibia much thicker than the tarsus. Basal joint of tarsus distinctly set off from distal portion which sometimes is considerably thicker; the distal portion shows some well separated articles, but in other parts the articles are not, or only irregularly, clearly defined (cf. Fig. 9).

Locality — *Colombia*: 2 mi. W. of Alban, Condin Amarca, one each on Mar. 14 and 23, 1955.

This species is apparently related to *N. paraensis* from which it differs in having the paired dorsal sulci on the second tergite, in the

much shorter coxopleural process, and the sparser spining of the anal legs, etc.

Newportia atopa, n. sp.

Dark or brownish yellow, the head and last tergite with anal legs darker.

Length, about 15 mm.

Head with much abbreviated paired sulci on its posterior border. Antennae composed of twelve articles. Prosternum anteriorly produced, the margin presenting two gently convex lobes meeting at the middle in a shallow obtuse angle, the lobes with the usual chitinous rim.

First tergite with cervical sulcus angled at the middle; the usual fine paramedian sulci.

Paired longitudinal sulci complete on the second and following tergites. Tergites densely finely punctate. Sternites punctate, the median sulcus incomplete in all.

Last ventral plate with caudal margin straight. Coxal pores and process as in most species.

Anal legs with tarsus abruptly much thinner than the tibia, not distinctly divided into tarsus 1 and tarsus 2, its first article being but little longer than the second, composed of nine articles (cf. Fig. 8). Prefemur with the usual four stout spines on the ventral surface and with a series of spinules on the mesal face and a few also on the ectal face. The femur with two spines on mesal side, one at base and one just beyond the middle.

Locality — *Ecuador*: 36 mi. S. of Alausi, Chimborazo. One specimen, Feb. 20, 1955.

Resembling the Paraguyan *N. balzani* in not having the first tarsal joint of anal legs thicker than those following it but this joint relatively shorter in the present species. It also differs in having no spinules on the femur and in its much larger size.

Newportia caldes, n. sp.

Yellow, the head chestnut, the posterior end more dilute chestnut.

Length, 21 mm.

Head without sulci, sparsely punctate. Antennae composed of 16 articles.

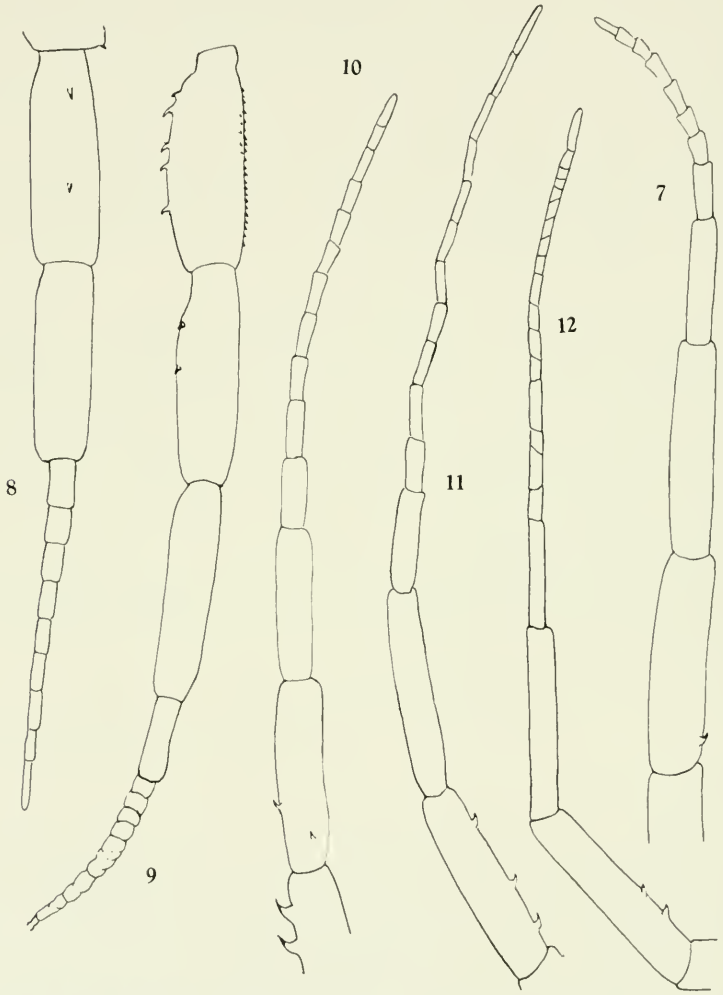
First tergite with cervical sulcus angled at middle; behind this two fine, anteriorly furcate sulci ending on the transverse sulcus. Anterior margin of the prosternum convex on each side, the median reentrant angle or notch very obtuse, the chitinous rim complete.

Paired dorsal sulci complete on second and subsequent tergites; a more or less oblique sublateral sulcus over anterior part of plate beginning on third tergite. Last dorsal plate with median lobe conspicuously convex.

Las ventural plate moderately narrowed caudad, the lateral mar-

gins convex, the posterior margin concave. Coxal pores numerous, extending to caudal margin of joint.

Anal legs with prefemur bearing the usual series of four large spines beneath and on ectal and mesal surfaces with finely tipped spinules. Femur with two spines, one, the larger, on mesal side at base and a smaller ventral one a little proximad of middle. Tibia



Newportia ecuadorana: Fig. 7, Anal leg distad of prefemur. *Newportia atopa*: Fig. 8, Left anal leg, mesal view. *Newportia albana*: Fig. 9, Right anal leg, mesal aspect. *Newportia caldes*: Fig. 10, Left anal leg distad of proximal half of prefemur. *Newportia schlingeri*: Fig. 11, Anal leg distad of prefemur. *Newportia rossi*: Fig. 12, Anal leg distad of prefemur.

thicker than the tarsus and about twice the length of the first tarsus. In the type the second tarsus composed of eleven moderately long articles the first of which is about half the length of tarsus 1.

Locality — *Colombia*: 2 mi. W. of Calarca, Caldes. Holotype taken Mar. 5, 1955.

Differing from *N. monticola* in lacking sulci on the head, in the convex anterior rim of the prosternum, and in the spining of the femur of the anal legs.

Newportia ecuadorana, n. sp.

Dull yellow, with head and first tergite chestnut.

Length, 18 mm.

Head with paired sulci across posterior border. Antennae composed of seventeen articles. Prosternal margin prominently convex and protruding, its rim not notched at middle (Fig. 7).

First tergite with a cervical sulcus which is very obtusely angled at the middle; the paired longitudinal sulci anteriorly furcate and ending on the transverse sulcus.

Paired sulci on the other tergites complete from the second on, the lateral sulci as usual.

Sternites with a median sulcus which on the anterior ones is complete.

Last ventral plate with convex sides converging caudad, the posterior margin incurved. Coxal processes of moderate length.

Prefemur of anal legs bearing a series of three stout teeth beneath, the spinules on mesodorsal face abortive. Femur with a single spine on mesal side at base. First tarsus abruptly thinner than the tibia; the second tarsus slightly differing in thickness from the first, composed of eight articles (cf. Fig. 7).

Locality — *Ecuador*: 2 mi. W. of Banos, Tungurahua. One, Feb. 5, 1955.

This species is closely related to *N. monticola*. It differs in the very convex prosternal margin as contrasted with the characteristically straight margin of *monticola;* in the well developed and complete sulcus of the anterior sternites; in having three instead of four spines in the ventral series of the prefemur of the anal legs and in having but one spine on the femur. Two smaller specimens agree with the type except in having four spines in the ventral series of the prefemur of the anal legs. One of these is from Ecuador without more definite locality and the other from 45 mi. S. of Alausi where taken Feb. 20, 1951.

Newportia monticola Pocock

Localities — *Colombia*: 27 mi. E. of Manizales, Caldas, three taken Mar. 16, 1955, one of these 45 mm. long which is exceptionally large for the species; 13 mi. W. of Cali, Valle, Feb. 20, 1955 and 6 mi. W. of Cali, Mar. 20, 1955. *Ecuador*: Largo Zurucuchu, 11 mi. W. of Cuerno, one, Feb. 16, 1955; 45 mi. S. of Alausi,

Feb. 20, 1955; 15 mi. N. of Quito, Feb. 27, 1955; Pichilinque, Feb. 2, 1955; and 2 mi. W. of Banos, Tungurahua.

Newportia rossi, n. sp.

Head with first and the last tergite orange in color, the rest of the dorsum brown mottled with blackish on lateral and caudal borders of the tergites and also down middle of some plates.

Length, 29 mm.

Head equal in length and breadth, without paired sulci, bearing numerous short hairs. Anterior margin of the prosternum straight, with the usual narrow chitinous rim.

First dorsal plate with a fine evenly curved transverse sulcus which runs close to caudal margin of head; no longitudinal sulci.

Paired sulci not evident on tergite 3 and vague on tergites 4 to 6; but well impressed on plates following 6; a coarser and deeper sulcus on each side, this not complete posteriorly. All sulci becoming deeper in proceeding caudad until the sixth from the last plate, after which they become less pronounced and are absent from the penult. Last dorsal plate short, its caudal margin straight across each of its lateral ends and strongly convex in between.

Tarsi of anterior legs, with the exception of the first few, distinctly biarticulate; a single dorsolateral tibial spine on legs beginning with the fourth.

Last ventral plate long, the sides gently converging caudad and rounding in at the caudal corners, the caudal margin short and straight. Coxopleural process long and acuminate.

Prefumur of the anal legs with the usual series of four large spines. Femur with two spinules on basal half of the joint. First tarsus scarcely more than half the length of the tibia; second tarsus of same thickness as the first, composed of 17 slender articles (cf. Fig. 12).

Locality — *Colombia*: 6 mi. W. of Cali, Valle. One taken Mar. 20, 1955.

A species close to *pusilla*, from which differing in lacking distinct longitudinal sulci on the first tergite and in the deep lateral sulci on the other plates, etc. It also seems to differ in the larger number of articles in tarsus 2 of the last pair of legs. The black mottling on the dorsal plates has not been noted for *pusilla*.

Newportia schlingeri, n. sp.

Color light yellow, the head and last tregite somewhat darker.

Length, 32 mm.

Head longer than wide in about ratio 19:17; widest posteriorly, moderately narrowing anteriorly; posterior margin widely convex; on dorsal portion showing two short paired sulci. Anterior margin of prosternum as a whole very convex, the median notch obtuse.

First tergite with transverse sulcus strongly angled; a pair of longitudinal sulci which branch anteriorly so as to form a W-mark

against the transverse sulcus in front of which it does not extend.

Complete paired sulci on second and following tergites; no true median keel; surface of tergites very finely roughened or somewhat shagreened.

Tarsus of anterior legs unarticulate, unarmed; the tibia with a dorso-lateral spine.

Last ventral plate rather broad, narrowing caudad, the caudal margin conspicuously incurved. Ectad of coxopleural process three denticles and typically a denticle subapical in position on the process.

Prefemur of anal legs with the usual series of four stout spines beneath; lateral and mesal surfaces with numerous reduced spinules. Femur ventrally with two, or sometimes but one, teeth,— one toward base and one distad of middle. Tibia armed. First tarsus somewhat less than half the length of the tibia, thicker than tarsus 2. Tarsus 2 consisting of 11-14 articles which are typically long (cf. Fig. 11).

Localities — *Peru:* 98 mi. E. of Olmos, Lambageque, one Jan. 19, 1955. *Colombia:* 3 mi. E. of Guaduas, Cundin Amarca, one, Mar. 15, 1955; 12 mi. NE of Buenaventura, Valle, Mar. 27, 1955.

This form differs from *N. monticola*, e.g., in having the anterior margin of the prosternum conspicuously convex instead of straight and in the position of the spines on the femur of the anal legs.

OVIPOSITION HABITS OF THE TICK *DERMACENTOR PARUMAPERTUS* NEUMANN AND FACTORS INFLUENCING EGG DEVELOPMENT[1]

Clive D. Jorgensen

Of the ticks known to inhabit the desert communities of the Great Basin in western United States, *Dermacentor parumapertus* Neumann is the most abundant and has the widest geographical distribution (Beck, 1955). Because of its large numbers and wide host and geographical distribution, it is an important tick economically and medically. Diseases known to be harbored by this species in nature are Colorado tick fever and a spotted fever-like rickettsia (Philip and Hughes, 1953; Kohls, 1955), and tularemia (Woodbury and Parker, 1954).

Experimentally *D. parumapertus* has transmitted Rocky Mountain spotted fever (Maver, 1911; Parker *et al.*, 1933), and tularemia (Parker, *et al.*, 1937; Allred *et al.*, 1956). Because of its vector potentialities, control methods may have to be developed. An understanding of the life history is necessary to develop controlling methods of the tick as well as the diseases harbored and transmitted by it.

Stanford (1934), Cooley (1938), Edmunds (1951), Beck *et al.* (1953), Coffey (1954), Beck (1955), Fremling and Gastfriend (1955), and Gastfriend (1955) have done much to clarify the host relationships, geographical distribution, and bionomics of certain stages in its life cycle, but previous work on the egg stage has been reported in two papers by Hooker *et al.* (1912), and Allred and Roscoe (1956).

The purpose of this study is to furnish more information on the oviposition habits of *D. parumapertus*. The inter-relationships of relative humidity, temperature, percentage of engorgement, pre-oviposition period,[2] oviposition period,[3] post-oviposition period,[4] oviposition rate, incubation period, host relationships, time of year, and possibly other factors are important concerning the life history of this tick. With the information obtained from this sudy, a better understanding of these phenomena and their influnece on egg development can be had.

I would like to express my appreciation to Ecological Research, University of Utah, Dugway, Utah and Brigham Young University, Provo, Utah for their support during the course of this investigation.

Methods and Materials

Two hundred and fifty black-tailed jack rabbits, *Lepus cali-*

[1]A thesis submitted to the Department of Zoology and Entomology, Brigham Young University, in partial fulfillment of the requirements for the degree of Master of Science. This study was supported in part by U.S. Army Chemical Corps contract No. DA-18-064-CML-2639, with the University of Utah.

[2]That time lapse between detachment and commencement of oviposition.

[3]The time during oviposition.

[4]That time lapse between the cessation of oviposition and death.

fornicus deserticola Mearns, collected in Skull Valley, Tooele County, Utah on August 2, 1955 were left at room temperature overnight to allow the engorging ticks to detach. Although most of the ticks did detach, some were removed with eye-muscle forceps. Of the engorged females which detached, a sample of 286 ranging from slight to apparently complete engorgement was selected for this study. Approximately the same number of ticks that were forcibly removed was used for comparative purposes.

Each tick was placed in a two-dram shell vial which was then plugged with gauze-covered cotton and stored in one of five different relative humidity conditions: (1) 100% R.H., (2) 93% R.H., (3) 81% R.H., (4) embedded two inches in moistened vermiculite (a commercial insulation material), (5) embedded two inches in moistened sand. All ticks were kept at room temperature which varied from 78° to 86°F. with an average daily mean of 81°F.

The method used for determining the percentage of engorgement was the same as that used by Allred and Roscoe *(op. cit.)*. The largest tick collected, weighing 726.7 mgs., was assumed to be 100% engorged and was used as the standard by which the degree of engorgement of other ticks was determined.

The method used by Allred and Roscoe *(op. cit.)* for the calculation of egg numbers was used in this study. Eight groups of 100 eggs each were weighed and the average weight of an individual egg was determined. This method facilitated the calculation of egg numbers in mass and eliminated the tedious task of counting individual eggs.

To facilitate the handling of eggs, the ticks were divided into weight categories of multiples of 50 mgs. Daily records were kept of the eggs deposited by each tick within each category. The eggs laid each day by all ticks within each category were placed in a separate vial, a new set of vials (one for each category) being used each day. All eggs were kept at a relative humidity of 93% and room temperature.

In order to understand more fully the weight relationships of the engorged ticks and their eggs, each tick was weighed after oviposition was completed and the total weight of the eggs deposited calculated. From these weights and the original weight of the engorged female before oviposition, the loss of weight due to catabolism was determined. This provided a means of determining the efficiency of egg production by each tick.

Three natural desert habitats were simulated, i.e. (1) moist sand without vegetative cover, (2) dry sand without vegetative cover, and (3) dry sand covered with debris shed by a greasewood plant, *Sarcobatus vermiculatus*. All areas were contiguous, and provided with rocks, trunks of bushes, and artificial burrows. Engorged ticks were placed on dry sand and permitted to choose their direction of travel. Data obtained from other studies made by observation of ticks in similar habitats in the field were compared with the laboratory observations

Results

The ticks kept at a relative humidity of 93% required the shortest average pre-oviposition period of 7.8 days. Ticks kept in sand in the laboratory required the longest period of 10.3 days, whereas ticks oviposited in the field within seven days. The average for all ticks which oviposited in the laboratory was 9.3 days (Table 1). No differences were detected between the ticks which were

TABLE 1

Pre-and post-oviposition periods (in days) of *Dermacentor parumapertus*

Holding Condition	Minimum		Maximum		Average	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
100% R.H.	7	<1	25	14	8.9	5.4
93% R.H.	6	1	18	19	7.8	5.5
81% R.H.	7	<1	21	16	9.5	6.0
Vermiculite	7	1	22	16	9.6	4.6
Sand	7	1	25	17	10.3	7.0
Average					9.3	5.7

pulled off and those that detached themselves. There was no correlation between the length of the pre-oviposition period and the percentage of engorgement.

Sixty-six per cent (188) of the ticks deposited eggs while 34% (98) did not. Thirty-one per cent (30) of the non-ovipositing ticks weighed less than 33.4 mgs., 69% weighed more. Although one tick oviposited when only 4.5% engorged, most were at least 11% to 15% engorged before ovipositing.

The largest tick collected weighed 726.7 mgs. and deposited 6,242 eggs in the laboratory. However, the largest number of eggs (6,563) was deposited by a tick weighing 703.3 mgs. (96.7% engorged). The minimum number of nine eggs was deposited by a tick which weighed 36.3 mgs. (4.9% engorged).

The oviposition period ranged from 3 to 25 days with an average of 15. Fifty-five per cent of the ticks required less than 12 days, while 25% required more than 18 days. There was a very rapid increase in the oviposition period in the ticks from 4.5% to 25% engorgement. As the percentage of engorgement increased beyond 25%, a steady but much less rapid increase in the oviposition period was evident. The relative humidity and temperature conditions under which the ovipositing females were held had no apparent influence on the oviposition period.

Ticks required from 3 to 24 days to complete oviposition, and during the first one-third of the oviposition period, 35% to 60% of the eggs were deposited. During the second one-third of the oviposition period, an average of 30% was laid. An average of 55% of the eggs was deposited by the end of the first one-third of the

oviposition period, and an average of 81% by the end of the second one-third.

Ticks from 4.5% engorgement had no peak in their oviposition period. Those of 8.0% to 14% engorgement had a peak on the second day. Those ticks from 15% to 42% engorgement had a peak on the third day, those of 43% to 94% on the fourth day, and those of 95% to 100% on the fifth day. In cases where a peak was evident, it was reached within the first 20% of the oviposition period, after which there was a gradual decrease to completion.

With the exception of 5 ticks which were 25% engorged, the number of eggs deposited was directly proportional to the percentage of engorgement.

Ticks less than 7.0% engorged deposited an average of 0.97 eggs per milligram of total body weight. Those from 7.0% to 34% engorgement averaged 0.19 eggs per milligram of body weight, and those from 34% to 100% averaged 0.12 eggs. The lowest average recorded for any one category was 0.11 eggs per milligram of body weight.

As the percentage of engorgement increased, the percentage of the total weight loss due to egg deposition increased until 90% engorgement was reached, at which time a tendency to level off was noted. The percentage of weight loss due to catabolism decreased steadily as the percentage of engorgement increased.

The shortest average post-oviposition period of 4.6 days was demonstrated by ticks in vermiculite, whereas the longest average period of seven days was demonstrated by ticks in sand. An average of 5.7 days was maintained by all of the ticks that oviposited (Table 1). There was no correlation between the post-oviposition period and the percentage of engorgement.

There was no apparent correlation between the percentage of engorgement and the number of days between detachment from the host and death.

Thirteen of the 16 ticks introduced into the simulated natural habitat enclosure burrowed one-half to one inch below the surface of the plant debris to deposit their eggs. Two were accidentally trapped in a hole of the moist sand and one was unaccounted for. All ticks observed in nature crawled into debris where they were later relocated with their respective egg masses.

The egg size ranged from 0.46 mm. to 0.52 mm. in length with an average of 0.47 mm. The transverse diameter ranged from 0.38 mm. to 0.41 mm. and averaged 0.39 mm. No deviations beyond these limitations were observed. Individual eggs averaged 0.08 mg. in weight.

The incubation period ranged from 19 to 35 days, and varied within and between the various humidity conditions. The percentage of engorgement did not influence this period. The time within the oviposition period that the eggs were deposited had no apparent influence on the incubation period.

Discussion and Conclusions

Pre-oviposition Period.— The shortest average pre-oviposition period of 7.8 days was maintained by ticks held at a relative humidity of 93%; the next shortest period of 8.9 days was in 100% R.H. Ticks held at 81% R.H. and in vermiculate averaged 9.5 and 9.6 days, respectively. From ticks collected in July and August, Hooker *et al. (op. cit.)* recorded a minimum pre-oviposition period of five and a maximum of six days, but the relative humidity was not reported. This differs from the average of 10 days in 81% R.H. and seven days in 95% R.H. at room temperature as recorded by Allred and Roscoe, *(op. cit.)* who collected their specimens during July. In this study no ticks began oviposition as soon as the five days indicated by Hooker *et al.* Allred and Roscoe observed a decrease in the pre-oviposition period when the relative humidity was increased from 81% to 95%. The ticks in this study followed the same general trend. but an average as low as seven days was never attained.

Even though relative humidity affected the pre-oviposition period, the latter is probably influenced by the temperature as well. Hooker *et al.* recorded the shortest time of five days at 85° F. Although not indicated, the ticks studied by allred and Roscoe were probably kept at an average mean temperature of less than 85% F, as were those of this study. This being the case, temperature can easily be correlated with the length of the pre-oviposition period. Smith (1946) proposed that an increase in the average daily temperature tends to reduce the pre-oviposition period in *Dermacentor variabilis*, but relative humidity has no effect on it. Hixon (1932) pointed out that temperature was a limiting factor in determining the length of the pre-oviposition period of *Ixodes sculptus.* He maintained that the ticks kept at temperatures of 37° and minus 3°C would not deposit eggs until the temperaure was changed to 24.5°C. Arthur (1945) indicated that the pre-oviposition period in *Ixodes ricinus* varies with the season, which implies a temperature influence. The effects of temperature on *D.parumapertus* are probably very similar to its influence on these other species.

Vermiculite more closely approaches the natural condition for oviposition than any of the other relative humidity conditions in the laboratory. Consequently ticks in nature may be expected to have an average pre-oviposition period of about 9.6 days though they were observed to begin as soon as seven days.

The effects of temperature and relative humidity do not account for the individual variations among single specimens. Ticks apparently have other limiting factors which may be influenced by the habitat, but not controlled by it. The scope of this study did not include an investigation of these factors although the engorgement period (the time required for the tick to engorge after it has attached) might be suggested as a factor for consideration.

Since engorged females were not collected after they detached freely in nature, it is not known what percentage of engorgement a

tick will attain before detaching. Any one of several factors such as the role of the host's blood in simulating detachment, the condition of the host with respect to disease, rapidity of engorgement, food habits of the host, and the de-ticking activities of the host might limit the engorgement period which in turn may influence the pre-oviposition period.

Percentage of Engorgement and Egg Deposition. — The percentage of engorgement is apparently the factor which determines whether or not the tick will oviposit. Allred and Roscoe *(op. cit.)* stated that 45 of the 54 ticks that did not deposit eggs weighed less than 60 mgs. In the present study, 30 of 98 non-ovipositing ticks weighed less than 33.4 mgs. (4.5% engorged), which was the lowest limit at which ticks oviposited. Most ticks required at least 11% to 15% engorgement before they began ovipositing. A minimum of nine eggs was deposited by a tick 4.9% (36.3 mgs.) engorged. Allred and Roscoe recorded a minimum of 30 eggs, and reported the smallest tick to lay eggs as being 7.0% engorged. Under natural conditions, ticks probably would not detach voluntarily when only 4.5% engorged, and would therefore be more fully engorged and deposit more eggs.

Egg Numbers. — Allred and Roscoe *(op. cit.)* noted that the largest number of eggs, 6,587, was deposited by a tick weighing slightly less than 515 mgs. They did not indicate the number of eggs produced by their larest tick, which weighed 515 mgs. Hooker *et al. (op. cit.)* recorded a maximum of 4,660 eggs, but did not indicate the size of the tick ovipositing this number. In the present study, the largest number of eggs, 5,563, was deposited by a tick weighing 703.3 mgs. There is little doubt that fully engorged ticks may deposit more than 6,587 eggs, but the trend was for the maximum number of eggs to remain somewhat constant after this approximate number was reached. Engorged females may reach a point of diminishing returns, at which time a threshold of egg production is reached.

Oviposition Period. — The length of the oviposition period is dependent upon the percentage of the engorgement. Ticks from 4.5% to 25% engorged were extremely variable, ranging from 3 to 16 days, respectively. From 25% to 100%, the rise was much less variable, ranging from 17 to 24 days, respectively. The over-all average of 15 days is very close to the 15.9 days reported by Hooker *et al. (op. cit.).*

Oviposition Rate. — By dividing the oviposition period into three equal periods of time, differences in the deposition rate of the ticks were noted. The smaller ticks deposited as few as 35% of their eggs during the first one-third of their oviposition period, whereas the larger ticks deposited as much as 60%. All ticks deposited 30% of their eggs during the second one-third. Generally, as the percentage of engorgement increased, there was an increase in the relative percentage of eggs deposited during the first one-third of the oviposition period. Since the percentage during the second one-third remained constant at 30%, the reciprocal of the first one-third was maintained in the final one-third. Since there was no correlation

between the relative humidity and percentage of engorgement, it is evident that the rate of oviposition increases independently of the relative humidity as the engorgement more closely approaches 100%.

Ticks at least 7.0% engorged maintained a peak in their oviposition period which was reached at about the first 20% of this time. This probably is constant regardless of the relative humidity. The various conditions to which ticks are subjected probably alter the number of days required to reach the peak in oviposition, but not the percentage of the oviposition period at which the peak is reached. When optimum conditions are known, more work can be done to clarify this point.

Oviposition Efficiency. — Ticks less than 7.0% engorged deposited an average of 0.97 eggs per milligram of body weight, while those from 34% to 100% average only 0.12 eggs. From these data, it may be stated that with an increase in the percentage of engorgement, there is a decrease in the efficiency of the tick to utilize its blood meal. However, this decreased efficiency is not enough to offset the increase in egg potential as the tick continues to engorge.

Percentage of Engorgement and Egg Numbers. — A correlation between the percentage of engorgement and number of eggs deposited is evident. Allred and Roscoe *(op. cit.)* stated that there is a direct correlation between the degree of engorgement and the number of eggs deposited, suggesting no end to the number of eggs possible if the female could continue to engorge This puts the responsibility of limiting the egg number on the elasticity of the tick, or its ability to accommodate large amounts of blood. If a tick weighing less than 515 mgs. laid 6,587 eggs, as reported by Allred and Roscoe, a tick weighing 726.7 mgs should deposit more than 9,400 eggs. Because many ticks weighing 150 mgs. more than the highest egg producing tick did not exceed this figure, it appears that there are other limiting factors. Although many factors may influence this, it may be due to the degree of individual efficency to utilize the blood meal in egg production, as it is governed by enzymatic systems of the individual tick. It has been shown that this degree of efficiency was less among the larger ticks than among the smaller ones. This degree of efficiency among the larger ticks might be an expression of a predetermined number of eggs in the ovaries. It may be concluded that even though the percentage of engorgement influences the egg number, individual differences in efficiency are the limiting factors in the more completely engorged ticks.

Post-Oviposition Period. — A highly variable post-oviposition period was evident within the various relative humidity conditions. Allred and Roscoe *(op. cit.)* indicated a difference of from 1 to 14 days as compared to less than 1 to 19 days found in this study. Because of the wide variance in each of these conditions, it can be concluded that relative humidity is not the controlling factor.

Even though the degree of engorgement influenced the length of the oviposition period, it apparently was not the factor which determined the length of life from detachment to death. This was a

combination of the pre-oviposition, oviposition, and post-oviposition period, their inter-relationships, and the inter- and intra-relationships of factors which limit them.

Disposition of Eggs. — Engorged females follow the general pattern of most arthopods by seeking some degree of protection while depositing their eggs. In nature, ticks deposit their eggs in very shallow debris; however, even with this precaution there is a high mortality rate. The eggs are subjected to being washed away by rain, dessicated in dry seasons, and attacked by predators and parasites. However, since the debris is usually under brush, it furnishes the larval ticks with an excellent opportunity to locate their hosts.

Egg Size. — The egg size was about the same as that reported by Allred and Roscoe *(op. cit.)* except in no case were there any abnormally large eggs. The average size for all eggs measured was 0.47 mm. in length and 0.39 mm. in transverse diameter.

Incubation Period. — The factors limiting the incubation period might very well be a combination of the relative humidity as indicated by Allred and Roscoe, *(op. cit.)* and the accumulated temperature as indicated by Hooker *et. al. (op. cit.)*. Allred and Roscoe recorded an average of 32 days in 95% R.H. and 31 days in 81% R.H., both of which are higher than the 28 days in 93% R.H. recorded in this study. Because the temperatures of Hooker *et. al.* were higher than those of Allred and Roscoe and those of this study, the average incubation period observed by Hooker *et. al.* was probably somewhat shorter.

Summary

In this study, 250 jack rabbits, *Lepus californicus deserticola* Mearns, were collected and several hundred ticks of various degrees of engorgement were taken from them. The ticks were distributed in five different conditions of relative humidity: (1) 100% R.H., (2) 93% R.H., (3) 81% R.H., (4) moistened vermiculite, and (5) moistened sand. Approximately 400,000 eggs laid by 286 ticks were held at 93% R.H.

The pre-oviposition period ranged from 6 to 25 days with an average of 9.3 days. This period was influenced by the relative humidity and temperature, but the limiting factors lay within each individual tick. The oviposition period, which ranged from 3 to 25 days, was dependent upon the percentage of engorgement. The post-oviposition period ranged from less than 1 to 19 days and was dependent upon a combination of all factors influencing the tick from its detachment to its death.

Ticks began ovipositing when as little as 4.5% engorged, but most of those that oviposited were at least 11% to 15% engorged.

The number of eggs deposited by a single tick ranged from 9 to 6,563. The largest engorged tick recorded weighed 726.7 mgs

The efficiency of the tick in egg production decreased from 0.97 to 0.12 eggs per milligram of total tick weight as the percentage of engorgement increased. The rate of oviposition increased as the

percentage of engorgement increased. Ticks above 7.0% engorgement reached a peak in the oviposition period within the first 20% of the total time. Ticks below 7.0% engorgement had no peak.

There was a definite correlation between the percentage of engorgement and number of eggs deposited by each tick. The number of eggs deposited by individual ticks was influenced by the percentage of engorgement but not controlled by it. Individual efficiency of each tick to utilize its blood meal in egg production was variable, but seemed to be the factor limiting egg numbers in the larger ticks.

Engorged females sought debris, usually under brush, and deposited their eggs less than one inch below the surface. The eggs were about 0.47 mm. in length and about 0.39 mm. in transverse diameter The incubation period ranged from 19 to 35 days and was limited by a combination of the relative humidity and the accumulated temperature.

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NOTES ON A COLLECTION OF AMPHIBIANS AND REPTILES FROM SOUTHERN MEXICO, WITH A DESCRIPTION OF A NEW *HYLA*

Wilmer W. Tanner[1]

A small collection of 19 specimens of amphibians and reptiles, collected during the months of January and February, 1956, from Chiapas and Oaxaca is important because of several new records for the states and because it includes as well a new species of *Hyla*. Most of the specimens were taken near the town of Solistahuacán, located approximately 30 miles north of the state capital, Tuxtla Gutierrez and 40 miles east of Comitán, Chiapas.

I am indebted to Professor Ernest S. Booth of Walla Walla College, Washington, who with his students made the collection, and has graciously permitted me to examine and to report it. Dr. Hobart M. Smith has been kind enough to aid in certain comparisons, determinations and loans, and Dr. Doris M. Cochran has aided by the loan of comparative material from the U. S. National Museum.

AMPHIBIANS

Bufo valliceps Wiegman

One specimen taken along a small stream, 17 February, 40 miles east of Comitán, Chiapas.

Hyla macrotympanum, n. sp.

Type: BYU No. 13752, an adult female from 10 miles east of Chiapa de Corzo, Chiapas, collected by Robert Bohlman on January 30, 1956. Found on a tree trunk near a small stream.

Diagnosis: A medium sized *Hyla*, related to *miotympanum* and perhaps *darlingi*, but differing from these in having a tympanum more than one half the size of the diameter of eye; snout pointed; upper lip with a median notch; snout moderately long; a straight transverse series of prevomerine teeth; and with the tongue free and notched behind.

Description of type: Snout to vent length 35.3 mm; head width 12.6 mm; tibia 20.2 mm; width of eye lid 3.9 mm; length of orbit 4.1 mm; orbit to nostril 3.4 mm; length of snout 5.0 mm; head not flattened, skin loose, not attached to skull; interorbital distance (4.2 mm) noticeably larger than diameter of eye (3.2 mm); diameter of tympanum (2.0 mm) more than half the diameter of eye; canthus rostralis sharp, interrupted by the enlarged upper edges of the naris, and then continuing to form a pointed snout; loreal region oblique, not concave; dermal fold extending from posterior edge of orbit to axilla and covers the upper edge of tympanum; upper lip with a distinct median notch; anal flap moderate in size.

Choanae oval; five prevomerine teeth in a straight transverse

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series on each process, not angular and located midway between the anterior and posterior edges of the choanae; distance between patches of prevomerine teeth distinctly less than distance to choanae; tongue broadly heart shaped, free posteriorly and with a distinct notch; maxillary teeth light brown.

Fingers one half webbed; thumb with little webbing; pads wider than long and larger than digits; pad on middle finger largest, equal in size to tympanum; pad on thumb smallest; first finger noticeably shorter than second, its tip not reaching the lower edge of pad of second finger; postsubantebrachial ridge well developed and nearly uniform; heels of adpressed hind legs reaching between eye and naris; subarticular tubercle on outer finger distinctly bilobate (appearing as two), other subarticular tubercles small and simple; a series of five well-developed tubercles extending from base of outer finger to heel; thenar tubercle large and followed by two smaller subequal tubercles; many small tubercles scattered over the surface of the palmar surface.

Toes nearly fully webbed; half of last phalanx of fourth toe free; inner metatarsal tubercle moderate in size, oval, inner tarsal fold, a triangle-shaped ridge, not flaplike; outer edge of tarsus round, no sign of fold; pads smaller than tympanum and that of the middle finger; subarticular tubercles small, round; many small tubercles under digets and sole of foot.

Dorsal surface brownish (alcoholic specimen) with irregular spots forming two complete and one incomplete bars on back; larger spots formed by numerous, fine, closely placed stipples; no small spots or flecks scattered over the body; legs with some stippling but without cross bars; anal flap and anal region more heavily stippled and margined above by a light stripe; no other noticeable light stripes on head, body or limbs.

Remarks: Only after repeated comparisons with related species and an intensive study of all descriptions and keys have I attempted to describe a new species from a single specimen. However, the present specimen is so unique and morphologically distinct from all other related species as to warrant a description. Furthermore, it is from a remote area, in which few closely related *Hyla* have as yet been secured. It has been compared with *Hyla miotympanum* and the type of *Hyla darlingi*. These species are seemingly most closely related to *Hyla macrotympanum* but are, in each case, with a number of distinctive variations which are beyond the expected range of variation in a species. The larger tympanum, arrangement of the prevomerine teeth and the bilobate subarticular tubercle on the outer finger are especially distinctive.

REPTILES

Anolis compressicauda Smith and Kerster

One specimen taken 23 January, in a heavily forested area 15 mi. south of Jesus Carramza, Oaxaca.

Anolis biporcatus Wiegmann

One specimen taken 17 February, from brush along a small stream, 40 mi. east of Comitán, Chiapas.

Phrynosoma asio Cope

One specimen taken 12 January, at Salina Cruz, Oaxaca.

Sceloporus v. variabilis Wiegman

One specimen taken 17 February, 40 mi. east of Comitán, Chiapas.

Sceloporus malachiticus taeniocnemis Cope

Two specimens taken in a tropical rain forest, 6 February, Solistahuacán, Chiapas.

Sceloporus s. siniferus Cope

Two specimens taken 24 January, at Salina Cruz, Oaxaca.

Cnemidoophorus d. deppii Wiegmann

One specimen taken 24 January, at Salina Cruz, Oaxaca.

Gerrhonotus l. liocephalus Wiegmann

One specimen taken 6 February, at Solistahuacán, Chiapas. A subadult male with the following characteristics; dorsals 54 ventrals 39; tail complete and with 93 caudal whorls; loreal-canthals 3-4; supranasals present; azygous prefrontal slightly broader than long; frontal in broad contact with interpartial; supralabials 10-10; infralabials 8-8; and postmental single. Total length 117 mm., snout-vent 43 mm., tail to body ratio 1.17. Dorsal bands obsolete; venter and throat with numerous dark spots.

The present specimen is obviously not a representative of *l. austrinus* found in southwestern Chiapas, although it is closely related. This represents a southward extension of the range of *l. liocephalus* as well as a new state record for Chiapas.

Dipsas dimidiatus (Günther)

One specimen, BYU No. 13734, taken 17 February, 40 mi. east of Comitán, Chiapas. It is an adult male with the following characteristics: total length 643 mm., tail 207, tail into total length .321; scale rows 15-15; ventrals 189; caudals 114; supralabials 8-8, anterior ones higher than wide; infralabials 9-9; preoculars 2-2; postoculars 2-2; temporals 1-2; loreal absent; nasal single; upper preocular dividing the supraocular and the large preocular and lying between the orbit and prefrontal; mental followed by an azygous scale, which is followed by three pair of chinshields; first pair largest, all longer than wide and with the last pair divergent; first three pair of infralabials in contact with azygous scale, posterior part of azygous scale wedged between the anterior chinshields.

Head broad, strongly constricted behind; body laterally compressed, long and slender, tapering into an elongate thin tail. Eye large, pupil vertically eliptical; snout blunt.

Dorsum of head black, except for small central reddish spots on parietals; a small dark spot on the median pair of chinshields; body with alternating reddish and bluish bands across the dorsals; ventrals with alternating dark and white bands, red on dorsals to edge of ventrals, ventral blue in contact laterally with the reddish dorsal bands. Dark body bands 29, dark tail bands 17.

Variations: The large scale between the orbit and nasal scute is considered to represent an enlarged preocular, thus in this specimen the loreal is not present. It is apparently different to those specimens previously described (Smith 1943: 470) and including the type (Gunther 1894: 143-4, pl. 51), in having a small upper preocular which prevents the prefrontal from entering the orbit.

Although the type locality is listed as "Mexico," no definite locality has been previously recorded. Thus, the present record is not only new for Chiapas, but is the first definite one for Mexico.

Ninia s. sebae (Duméril, Bibron, and Duméril)

Two specimens taken 6 February, at Solistahuacán, Chiapas.

Pliocerous e. elapoides Cope

One specimen taken 10 February, at Solistahuacán, Chiapas. This record extends the range southward and is a new state record for Chiapas.

Leptodeira annulata polysicta Günther

Two specimens, one taken 28 January, at Tapanatepec, Oaxaca; and one taken 6 February, at Solistahuacán, Chiapas. The latter specimen had recently eaten an *Anolis compressicauda*.

Leptodeira maculata Hallowell

One specimen taken 20 February, at Tuxtla Guit, Chiapas.

Bothrops mexicanus (Duméril, Bibron, and Duméril)

One specimen taken 7 February, at Solistahuacán, Chiapas.

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JOSEPH RICHARD SLEVIN (1881-1957)

Vasco M. Tanner[1]

Members of the California Academy of Sciences and Herpetologists will greatly miss the genial and cooperative help of Joseph R. Slevin who died February 15, 1957, at the age of 75. For 53 years Mr. Slevin had been connected with the Academy. He first served as a collector and understudy of Dr. John Van Denburgh, next as heppetologist on the Galapagos Island Expedition sent out by the Academy in 1905-1906 and finally as a capable curator of the Department of Herpetology following the death of Dr. Van Denburgh in October, 1924.

Mr. Slevin must be given much of the credit for collecting and preserving the enviable collection of more than 75,000 specimens of amphibians and reptiles now in the Academy collection. This collection has been brought together following the fire and earthquake in San Francisco in 1906. At the time of the earthquake, the Academy herpetological specimens numbered 8,100 of which number only 13 were saved from the fire.[2]

The Department of Herpetology of the Academy was organized in 1895 with John Van Denburgh as the first curator. In 1908 Dr. Joseph C. Thompson, a surgeon with the United States Navy, was appointed assistant curator of herpetology. This position was, however, terminated in 1912. During Dr. Thompson's association with the Academy he added his rather large collections of reptiles, which he had made in Japan, Formosa and the Philippine Islands to that of the fast growing Academy collection.

Mr. Slevin, as the second curator of herpetology at the Academy, made collections from many areas between the years 1905 and 1953. Because of the interest students of the reptiles have in the sources of a collection as now found at the Academy, the collecting trips he made are given in some detail. His first trip was made to the Revillagigedo Islands, Mexico and the Galapagos Islands in 1905-1906. This expedition returned 4,506 specimens as a nucleus for the new collection at the Academy. Many specimens were rare gigantic land tortoises from the Galapagos Islands. Fourteen species of land tortoises have been reported from these islands, thirteen of which are

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1. Contribution No. 152, Department of Zoology and Entomology, Brigham Young University, Provo, Utah.
2. Joseph R. Slevin and Alen E. Leviton, 1956, Holotype Specimens of Reptiles and Amphibians in the Collection of the California Academy of Sciences, Proc. Cal. Acad. of Sci., Vol. 28, 4th Series, No. 14, pp. 529-560.

Joseph Richard Slevin, Curator of the Department of Herpetology, California Academy of Sciences, 1924-1957.

now represented in the Academy collection, five of the species by type specimens.[3] Mr. Slevin again visited these islands in 1928-1929.

In 1911, 1919 and 1953, Mr. Slevin collected along the coastal and interior regions of California, Oregon and Washington; 1912, 1920 and 1947 in Arizona; 1913 and 1916 in Nevada and Utah; 1913 Tehachapi Mountains, California; 1915 in Southern California, Nevada and Utah; 1917, 1927 and 1951 Southern California; 1919 Cape Region, Lower California, Mexico; 1923 San Pedro Martir Mountains, Mexico; 1924 and 1926 Guatemala; 1926 Farallon Islands, California; 1929-1930, 1936-1937, 1947-1948 in Australia; 1931 Death Valley, California; 1939 Panama; 1940 Cedros Islands, Lower California, Mexico; and 1951 Lower California, Mexico.

Mr. Slevin's collection trip into Salt Lake, Summit, Wasatch, Utah, Emery, Grand and Beaver Counties of Utah in 1913 was one of the early careful studies to be made of the reptiles found in this state. Although he succeeded in getting only 36 of the now recog-

3. John Van Denburgh, 1914. Expedition of the California Academy of Sciences to the Galapagos Islands. Proc. Calif. Acad. Sci. 4th Series, Vol. II, pt. 1, pp. 203-375; pls. 12-124.

nized 78 species reported from this area, he did bring together a sizeable series of most species and extended the range of some forms.

The great contribution made by Dr. John Van Denburgh through his monumental work "Reptiles of Western North America"[4] was made possible to a great extent through the efforts of Mr. Slevin. Joseph R. Slevin was the junior author with Dr. Van Denburgh on twelve publications and the sole author of 47 papers.[5]

I first became acquainted with Mr. Slevin in 1920 and through the years found him to be most cooperative and willing to loan or exchange specimens as we have carried on our study of the reptiles of the Great Basin. A visit to the Academy was not complete until one sat with Joseph Slevin in his office and working quarters.

Throughout his long tenure as an employee of the Academy, which resulted in his being elected as an honorary member in 1954, he was a devoted and loyal supporter of the Academy. He also loved the sea and as a true American served his country as a submarine officer in World War I and would have served in a like capacity in World War II but was not accepted because of his age.

Would that we had many other such curators and devotees to herpetology as was Joseph R. Slevin. Long may his kindly influence and spirit abide in the herpetological halls of the California Academy of Sciences.

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4. John Van Denbburgh. 1922. Reptiles of Western North America. Occasional Papers of the California Academy of Sciences. 2 Vols., pp. 1028, pls. 128.

5. Joseph R. Slevin and Alen E. Leviton. *Op. Cit.*

APR 2 3 1958

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PUBLISHED BY
BRIGHAM YOUNG UNIVERSITY

The Great Basin Naturalist

A journal published from one to four times a year by the Brigham Young University, Provo, Utah.

Manuscripts: Only original unpublished manuscripts, pertaining to the Great Basin and the Western United States in the main, will be accepted. Manuscrtipts are subject to the approval of the editor.

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All correspondence dealing with manuscripts, subscriptions, reprints and other business matters should be addressed to the Editor, Vasco M. Tanner, Great Basin Naturalist, Brigham Young University, Provo, Utah.

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The Great Basin Naturalist

Published by the
Brigham Young University, Provo, Utah

Volume XVII December 31, 1957 Nos. 3-4

A TAXONOMIC AND ECOLOGICAL STUDY OF THE WESTERN SKINK (Eumeces skiltonianus)

Wilmer W. Tanner[1]

Introduction

The most widespread and perhaps the most abundant skink in western North America is *Eumeces skiltonianus* Baird and Girard. This species occupies a wide area extending from southern British Columbia southward to the mountains of northern Baja California and westward through the Great Basin to the southern high plateaus of Utah and northern Arizona. The distribution is essentially that given by Stebbins (1954:322) except for the inclusion of extreme southern Utah and northern Arizona. Smith (1946:601) added Arizona and also an isolated area in southeastern Utah. The latter was presumably based on a specimen (BYU 534) taken near the Bears Ears, Elk Ridge, San Juan County. A re-examination places this specimen with the *multivirgatus* complex, more likely *Eumeces gaigei*, and adds a new species to the Utah list. To my knowledge *skiltonianus* does not exist east or south of the Colorado River, although it does reach the rim of the Grand Canyon in northern Arizona.

Other recent studies concerning the species *Emeces skiltonianus*, by Talyor (1935), Rodgers and Fitch (1947), and Stebbins (1954), have included specimens from the above area as a single form. Most of the material available for the above studies came from California, Oregon, and Washington, with comparatively small series from widely separated localities east of the Sierra Nevada's. Each of the above studies contribute to a more complete understanding of the *skiltonianus* group (*E. skiltonianus* and *E. gilberti*); however, the availability of a large series from the coastal states, principally California, aided in clarifying the taxonomic status of the skinks of this state, primarily that of *Emueces gilberti* and its subspecies. Up to now, taxonomic studies concerning the skinks of the eastern axis of the Great Basin, including primarily the Bonneville basin, and the Snake River valley of southern Idaho have done little more than to list the representatives available as *Eumeces skiltonianus* and to indicate a need for further study of the variations known to exist in the species.

Although previous studies, Taylor (1935), Tanner (1943), Smith (1946), and Rodgers and Fitch (1947), have given valuable informa-

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tion concerning the ecology, life history and taxonomy of *skiltonianus*, these studies included relatively few specimens outside of California. For example, Taylor (loc. cit.) in his extensive study lists 52 specimens from all of the states north and east of California, more than 70 from Baja California, and more than 360 from California. Woodbury (1931) lists seven localities from Utah, (some published previously) and perhaps saw relatively few specimens. Rodgers and Fitch (loc. cit.) carefully studied and reported a large series of specimens from California. Thus when the present study was begun in 1950, only a few specimens were available for taxonomic study and these from widely separated localities.

Preliminary comparisons of the Utah series (Utah County), with the few specimens available from Oregon (Clackamas, Marion and Douglas Counties), indicated at the outset that there were substantial variations. In order to determine the extent of these differences and to discover, if possible, other variables in the populations of this species, extensive field work was undertaken in Utah and adjoining areas. The additional specimens collected, and those seen and borrowed from other museums, have provided a series of over 300 specimens from areas north and east of California. All of the distributional gaps are not yet filled. There are data available, however, to indicate significant varations within this widely distributed species, as well as unrecorded ecological notes. Additional collecting should be done in the extreme northeastern part of California, northern Nevada, southeastern Oregon, and Idaho.

For the privilege of examining and of borrowing specimens for use in this study, I wish to thank the following: Doctors George S. Myers, Jay M. Savage, and Mr. A. E. Leviton, Stanford University (SU); Mr. Joseph R. Slevin, California Academy of Sciences (CAS); Dr. Stephen D. Durrant, University of Utah (UU); Drs. Ross Hardy and Richard B. Loomis, Long Beach State College (LBSC); Dr. Doris M. Cochran, U. S. National Museum—for permitting the loan of types and for pertinent information concerning them (USNM); Dr. Ira LaRivers, University of Nevada (UN); Dr. George E. Hudson, The State College of Washington (SCW); Director of Idaho State Museum (ISM); Mr. Arthur Bruhn, Dixie Junior College (DC); Dr. Norman Hartweg, University of Michigan (UM); Mr. Louis Schellback, Grand Canyon National Park (GCNP); Dr. Robert C. Stebbins, Museum of Vertebrate Zoology, University of California (MVZ); Dr. Robert M. Storm, Oregon State College (OSC) who has provided me with an unusually large series from Oregon; and to Drs. Henry S. Fitch and Edward H. Taylor, University of Kansas (KU); and my colleagues at Brigham Young University (BYU) for their criticisms of the manuscript and aid in the field work.

Types and Type Locality

According to the records in the United States National Museum, the specimens used in the original description of this species now bear the number 3172. There are two specimens, both separately tagged, but in accordance with earlier procedures, both have the same

number. One is an unusually large specimen, 83 mm snout to vent, whereas the other is of average adult size, 64 mm.

The following general characteristics obtain in the cotypes In each case the first figure refers to the larger specimen. Scale rows, 25-26; dorsals, 63-60; ventrals, 45-46; width of the first nuchal (distance from parietal across first nuchal to edge of second nuchal), 1.4-1.5 mm.; width of the dorsolateral line (taken near or just before the middle of body), 2.0-1.2 mm; percent of dorsolateral line on second scale row, ½-½; superalabials, 7-7, 8-8; infralabials, 6-7, 6-7; lateral line edged ventrally by a narrow dark stripe, not so in the larger but present in the smaller specimen.

In the original description (Baird and Girard, Proc. Acad. Nat. Sci., Philadelphia, 6:69, 1852)[2], the Reverend George Gary is listed as their collector, and the habitat (type locality) is listed as Oregon. Unfortunately, the description is brief and deals only in generalities, thus giving no clues as to which of the two specimens now listed as cotype may have received the most consideration, or if other specimens were at hand for examination.

As a part of the report on reptiles made by Baird (1853:349-50) (appendix C, Stansbury Expedition to the Great Salt Lake; fig. 4-6), the characteristics of this species are discussed at greater length, and a specimen of this species is figured. The larger cotype is apparently the one figured, inasmuch as the tail is broken at approximately the same place; the dark edge below the lateral stripe is absent and most important of all the head plates (as figured) are identical for this specimen. The latter is significant because the larger cotype has several aberrant head scales. These are particularly noticeable in the nuchals. An examination indicates that the nuchals, as figured by Baird (pl. 4 fig. 6) are nearly identical, even to the small dark spots along the sutures of the head plates.

Cope (1900) lists the locality for the types as "California." Stejneger and Barbour, (check list, 1917-1943), and Schmidt (1953), lists the type locality as "Oregon." To add to the uncertainty, the two specimens (cotypes) were entered in the catalogue (USNM) on July 21, 1858, and California is given as the locality. This led Taylor (*loc. cit.*) to question the validity of the larger cotype and to designate the smaller type as the lectotype. Dr. Doris M. Cochran informs me that Dr. Stejneger numbered the specimens "A" and "B", and wrote on the file card, "Spec. A is the one figured" in Stansbury's Expl. Surv. Valley of the Great Salt Lake, 1853, pp. 349-50, pl. 4, fig. 4-6. On this same card, "California" is crossed out and "Oregon" is written in. I have seen both types and have compared them, particularly the larger one, with the description and figures. Although the larger specimen is aberrant in having only one pair of small nuchals and in lacking the dark stripe below the lateral stripe, otherwise it is a normal specimen when compared with skinks from north central Ore-

2. According to Taylor (loc. cit.) this description actually appeared in 1853 perhaps only shortly before the Stansbury Expedition report by Baird.

gon. Also the smaller cotype is an average specimen when similarly compared (see below). There is, I believe, no real reason to longer doubt their validity as types.

As to the type locality the following statements from Baird and Girard's report (1863; p. 350) leave little doubt. "This species inhabits the same location in Oregon as *Elgaria scincicauda*. The specimen figured, together with several others were collected by Rev. George Gary, and sent by him to Dr. Avery J. Skilton, . . ."

On page 349 the locality for *Elgaria scincicauda* is given as follows: "This species inhabits Oregon, about the Dalles of the Columbia River, where it has been collected by Rev. George Gary." (1st sentence only).

A comparison of the cotypes with specimens from various localities in north central Oregon has shown a greater similarity between the types and those specimens which come from that tier of counties extending south from the vicinity of the Dalles, along the Deschutes River (Hood River, Wasco, Jefferson, and Deschutes Counties). Skinks from these counties tend to average more ventrals, ranging from 40 to as many as 46 in a few specimens, and commonly to have 60 or more dorsals. The dorsolateral stripe is slightly wider, and when compared with the width of the first nuchals (see Plate 2), yields on the average a smaller figure than do specimens seen from the more western part of Oregon.

A sizeable series from the lower Williamette Valley, east of Salem and Oregon City, vary with the series from the Deschutes Basin and with the cotypes in that there are fewer venrals, usually 40-43, rarely more, and there are usually less than 60 dorsals. In the series from western Oregon, the dorsolateral stripe is perhaps the narrowest found in the species.

On the basis of all data now available, it is seemingly possible to establish the type locality in Oregon, and most likely from the area around The Dalles, or from that area immediately to the south of The Dalles in the Deschutes River Basin.

As the skinks from California and Baja California are examined and compared, one is impressed with the differences between those from San Bernardino and Orange Counties north, and those from extreme southern San Diego County, northern Baja California, Todos Santos Island and the various Cornado Islands. Both Taylor (*op. cit.*) and Rodgers and Fitch (*op. cit.*) found the interparietal enclosed by the parietals in a high percentage of the specimens seen from the southern part of the range. For San Diego County 70 per cent were enclosed. In addition I found an extension of the body pattern onto the tail. Both of the above studies have treated the distributional variations of the skinks from California and Lower California more completely than those of the populations existing in the Columbia River Valley and Great Basin areas. However, it should be pointed out that the former study was based in many instances on insufficient material (Taylor 1935:414) thus necessitating some tentative conclusions. The study by Rodgers and Fitch (*op. cit.*) was by it very

nature not designed to engage in a study of the entire problem of variation in the species *Eumeces skiltonianus*, but rather to resolve certain taxonomic problems existing in the species *Eumeces gilberti* and to restate in view of the new data, the variations between the species belonging to the *skiltonianus* group.

With an increase in material it is now possible to make a comparative study of the variations within the species *Eumeces skiltonianus* Baird and Girard.

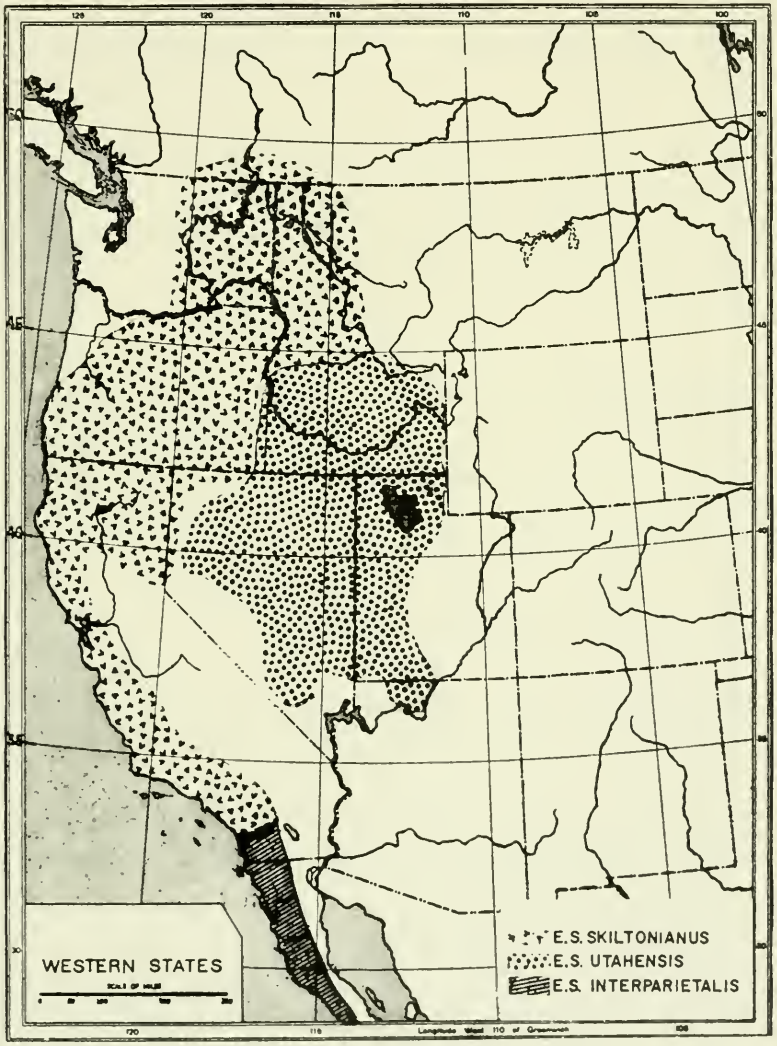

Plate 1. Distribution of the subspecies of *Eumeces skiltonianus*.

In the course of gathering data on the species *Eumeces skiltonianus*, a series of *Eumeces lagunensis* have been seen and compared with other species of the *skiltonianus* group of skinks. Although the data thus gathered do not provide us with all variations expected in this species, the increased material does give a better understanding of this skink than we have had previously. I am, therefore, including *lagunensis* in this study in order to properly relate it to the other species in the *skiltonianus* group and also to add to the known variations.

Eumeces skiltonianus is here considered to be a polytypic species (see plate 1), closely related to *gilberti*, a contiguous and at some areas an overlaping or sympatric species. Its precise relationship to *lagunensis* is still in doubt. On the basis of size, color patern (except for tail color) and in most scale formulae, *skiltonianus interparietals* and *lagunensis* are similar. Some of the differences (see species account) are seemingly significant as is also the wide geographical separation of the populations. Until additional information, particularly data concerning reproductive isolation, is available, further changes in the nomenclature seem ill advised. I am, therefore, considering *lagunensis* as a disjunct allopatric species.

Key to the Species and Subspecies

1. Seventh labial broadly in contact with the upper secondary temporal; tail of juveniles pink or salmon colored never blue; interparietal enclosed by parietals. ..... *Eumeces lagunensis* Van Denburgh

   Seventh labial rarely in contact with the upper secondary temporal; tail of juvenils either pink or blue; interparietal enclosed or not by the parietals. 2

2. Tail of young red, pink or blue; snout to vent length 80 or more mm; stripes of body pattern faded or absent in adults; nuchals usually 1-1. ..... *Eumeces gilberti* Van Denburgh (and its subspecies—see Rodgers and Fitch 1947:177).

   Tail of young blue; snout to vent length less than 80 mm; stripes of body pattern present in adults; nuchals usually 2-2. *Eumeces skiltonianus B. & G.* (and its subspecies) 3

3. Dorsolateral stripe occupying more than half of the second scale row and being nearly one half the diameter of the dark dorsal interspace. Dark stripe below lateral light stripe rarely present. Diameter of the dorsolateral stripe usually greater than the length of the first nuchal. ..... *Eumeces skiltonianus utahensis*, n. subsp.

   Dorsolateral stripe narrow not occupying more than half of either the second or third scale rows, diameter of stripe naticeably less than half the width of the dark dorsal interspace. Dark stripe below the lateral light stripe usually present. Diameter of the dorsolateral stripe usually less than the length of the first nuchal 4

4. Interparietal enclosed by the parietals in 80 per cent of the population. Stripes of the body pattern extended onto anterior half or more of tail ..... *Eumeces s. interparietalis*, n. subsp.

   Interparietal rarely enclosed by the parietals. Usually less than 10 per cent even in Los Angeles and San Bernardino Counties; and/or stripes of body pattern not extended on more than the base of the tail. ..... *Eumeces s. skiltonianus* B & G

Eumeces skiltonianus skiltonianus Baird and Girard
Western Skink

Plestidon skiltonianum Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1852:60, Original description, type locality, Oregon; Baird and Girard, in Stansbury's Expl. Surv. Val., Great Salt Lake, Rept. App. C, 1863:349-350, pl. 4, fig. 406.

Plestidon skiltonianus Van Denbrugh (part), Vol. I 1922:578-587.

Eumeces quadrilineatus Hallowell, Rept. U.S. Expl. Surv. R.R. Pt. 4X, 1859:10, pl. IX, fig. 3 (type locality, Mojave River, San Bernardino Valley, California.

Eumeces skiltonianus amblygrammus Cope, Ann. Rept. U.S. Nat. Mus., 1898 (1900):643, type locality, Fort Humboldt, Humboldt County, California.

Eumeces skiltonianus skiltonianus Taylor (part), University Kansas Sci. Bull. 1935:23, 415-428.

Eumeces skiltonianus Rodgers and Fitch (part), University of California Publs. Zool., 169-209, 1947.

Range: Extreme south central British Columbia, Washington east of the Cascade Mountains, western edge of Montana, northern Idaho, Oregon, except northwestern corner, edge of northwestern Nevada, northeastern California south to Placer and Yuba Counties, and western California south along the coast into northern San Diego County.

Diagnosis: Dorsolateral stripe narrow usually occupying no more than one half of the second scale row; dorsolateral stripe at middle of the body less than one half of the dark dorsal interspace. First nuchal noticeably larger than the second, length of the first nuchal greater than the width of the dorsolateral line. Lateral light stripes bordered ventrally by a narrow dark stripe.

Description of the subspecies: Scales smooth, rows around middle of body, 24 or 26, occasionally 25 or 27, rarely 28; dorsals, from parietals to base of tail, usually 58, 59, or 60 ranging from 53 to 63, average 59; ventrals ranging from 39 to 46, average 42.0; total dorsal-ventral scales 95-108, average 101; supralabials 7-7, 7-8, or 8-8, rarely 6 or 9, plate 3; infralabials 6-6, rarely 5 or 7; postlabials 1 or 2, rarely 3 or 4; postnasal and postmentals present; parietals divided by interparietal; usually two pairs of nuchals, occasionally one or three pairs, first pair noticeably larger than succeeding pairs; distance across first nuchal, 0.6-1.0 mm in young, 1.2 to 1.8 mm in adults; length of first nuchal greater than diameter of dorsolateral stripe.

Head distinct; body subcylindrical, slender and elongate; snout-to-vent lengths 25-28 mm in hatchlings, 60-78 mm in adults (excepting 83 mm in cotype); tail long, 1½ to approximately 2 times the snout to vent length; limbs well developed, when adpressed to body touching or overlaping in juveniles, males, and in most females.

Color patern consisting of four narrow light stripes and three broad brownish stripes; dorsolateral light stripes originate on supranasals, extend across supraoculars, temporals, parietals, nuchals, and along second and third scale rows, and for a short distance onto tail; lateral light stripes originate on supralabials, and extends posteriorly through ear, and along fourth and fifth scale rows to tail;

a narrow dark stripe borders ventral edge of lateral stripe; ventral scales grayish or mottled with bluish-green; lateral dark stripe a uniform chocolate brownish, extending from nasal to tail, less obvious on head and tail in older specimens; mid-dorsal dark stripe medium to light olive brown, extending from frontonasal posterior to base of tail, in subadults and adults edged with darker brown, similar to color of lateral dark stripes; tail bright blue in juveniles and subadults, faded blue-grayish or brownish in older adults; males with red on labials and temporals, pronounced in old males during mating season.

Habitat: Occurs in a variety of habitats from the Upper Sonoran, through the transition and into the lower limits of the Canadian Life-zone. Western skinks are more abundant in brush areas where rocks and logs provide opportunity for burrowing and concealment. Heavily forested areas do not carry dense populations of skinks.

Specimens examined: A total of 198 as follows:

CALIFORNIA: *San Bernardino Co.*: Fish Creek, San Barnardino Mts. (MVZ 674-6); Barton Flats, San Bernardino Mts. (MVZ 4293); 5.5 mi. N 3.5 mi. W San Gorgonio Peak (MVZ 44559); S Fork, Santa Ana River (MVZ 677); Santa Ana River (MVZ 708); San Bernardino Mts. (SU 5422). *Los Angeles Co.*: Los Angeles (AMNH 24298); Fish Canyon, San Gabrial Mts. (AMNH 9088); San Pedro (MMZ 3820). *San Benito Co.*: Canyon W of San Juan Bautista (MMZ 58898); Laguna Mts. (AMNH 22734). *San Luis Obispo Co.*: 60 miles W of Maricopa (MMZ 75672-3). *Monterey Co.*: Big Sur (MMZ 90717); Los Ranchitos, Carmel Valley (BYU 13901). *Santa Cruz Co.*: 3 mi. N of Corralitos (MMZ 66666-9). *Alameda Co.*: (KU 7279). *Santa Clara Co.*: Palo Alto (MMZ 53634 two specimens). *Marin Co.*: Mt. Tamalois St. Park (MMZ 107252, KU 8212); *Mendocino Co.*: 7 mi. W of Willits (MMZ 102651, SU 9222-4); Comptche (AMNH 20440-1). *Placer Co.*: Red Point (SU 4 and 5). *Tahama Co.*: 29.5 mi. E of Red Bluff (BYU 12467-76), 17 mi. E of Red Bluff (BYU 12466). *Sierra Co.*: Sierraville (UN 3117). *Shasta Co.*: Ft. Crook (USNM 45166). *Siskiyou Co.*: 2 mi. NE of Bartle (MMZ 110145). *Modoc Co.*:Ft. Bidwell (USNM 29609).

OREGON: *Josephine Co.*: 1 mi. E Cave Junction (OSC 9196). *Jackson Co.*: Lower Table Rock (OSC 1418-9), 1 mi. E of Sam's Valley (OSC 9270), Upper Table Rock (OSC 9350-2), 10 mi. N 1 mi. W Medford (OSC 9370-3). *Douglas Co.*: Junction Steamboat and Umpqua Rivers (BYU 2892), 4 mi. N of Drain (OSC 5887-9), 18 mi. NE of Tiller (OSC 6063), Boomer Hill 5 mi. SW of Myrtle Creek (OSC 9240), Umpqua Rivers, 7 mi. W of Elkton (OSC 9257), 15 mi. E of Roseburg (OSC 9227 and 9113), 3.3 mi. below Milo (OSC 9353). *Klamath Co.*: Between Ashland and Klamath Falls (USNM 25919). *Lake Co.*: Albert Rim (AMNH 73035). *Harney Co.*: Diamond (USNM 61417). *Lane Co.*: 3 mi. SW Monroe (OSC 1507-8), 6 mi. SW Monroe (OSC 1422, 9234), 3 mi. S, 2 mi. W Monroe (OSC 5918, 9301), 2 mi. SW Monroe (OSC 6421); 5 mi. S Eugene (AMNH 63984). *Deschutes Co.*: Deschutes River (USNM 13774), Cline Falls St. Park (OSC 9403-21), Dry Canyon (OSC 8022-26), 8 mi. E of Sisters (OSC 6473-4, 6557). *Linn Co.*: 5.3 mi. ESE Sodaville (OSC 8692-4), Trout Creek Camp, 8 mi. E Cascadia (OSC 1673-4, 1678, 1681, 778-9, 1505, 1530, 1541), Idanha (OSC 9282-3, 9299, 9295, 9172, 9207, 9272), Crawfordsville (OSC 8712-3), 1.5 mi. SW Stayton (OSC 5148), 5 mi. E Idanha (OSC 9278), 5 mi. E Sweet Home (OSC 6436), Ward Butte (OSC 9099), 1 mi. S Foster (OSC 1517). *Benton Co.*: 3 mi. E Kings Valley (OSC 5976), 4 mi. SW Apline (OSC 9292). *Marion Co.*: near Idanha (OSC 8751-2, 9308, 9261, 9250), 1 mi. E Idanha (BYU 11550), Salem (USNM 16176-7). *Yamhill Co.*: McMinnville (AMNH 73034). *Claskamas Co.*: Oswego (BYU 652), 1 mi. E. Clackamas (OSC 1550, 1556). *Hood River Co.*: 6 mi. SW Hood River (OSC 6222-3). *Wasco Co.*: SE Tygh Valley (OSC 8801-2). *Jefferson Co.*: 2 mi. E of Grissly (OSC 9286, 9289), Deschutes River (KU 38570).

Baker Co.: 12 mi. E Baker (OSC 9711-2). *Union Co.*: Perry (OSC 9805), 3 mi. S Elgin (OSC 9810-2, 9766), 1 mi. NE Thief Valley Reservoir (OSC 9815, 9865, 9765), Thief Valley Reservoir (OSC 9781, 9806). *Wallowa Co.*: (OSC 6938).

IDAHO: *Bonner Co.*: Clark Fork, Lower Kootenay River (USNM 6282); Pack River (WSC 48-26). *Nez Perce Co.*: Lake Waha (WSC 48-393). Locality unknown (USNM 66145).

WASHINGTON: *Asotin Co.*: Near Wood Spring (OSC 1498). *Grant Co.*: Dry Falls (UW 4 specimens, no numbers). *Okanogan Co.*: Okanogan (WSC 41-40). *Whitman Co.*: Pullman (WSC 48-142, 35, G.P. -16, one specimen no number, 41-43, 41-46, 47-85, and 28); Wilma (WSC 36). *Spokane Co.*: Spokane (WSC 42-192, 42-193). *Yakima Co.*: Selah (KU 23138 and 26033).

NEVADA: *Humboldt Co.*: 10 mi. N Paradise (UN 289). *Washoe Co.*: 5 mi. NW Reno (UN 290); Reno (UN 302 and 2162). *Douglas Co.*: Genoe (UN 2163).

BRITISH COLUMBIA: West Branch of Kootenai River (AMNH 26855).

Remarks: The type of *Eumeces quadrilineatus* Hallowell (USNM 3168) is in poor condition. The scales have been lost, the body is soft and the skull is broken in the parietal region. It was not possible to determine if the interparietal is completely enclosed by the parietals, if so then barely so. The supralabials are 7-7, other scale formulae could not be accurately determined and the color pattern is completely obliterated.

In the original description Hallowell (1859) refers to both the parietals and interparietals but does not give details as to their relationship to one another. The dorsal view of the head, plate 9, fig. 3-d, shows the interparietal dividing the parietals, and making a rather wide contact with the dorsals. The figure does not indicate the presence of nuchals in the type.

A series of specimens from the Majave River Valley, San Bernardino County are much more closely related to typical *skiltonianus* than to *interparietalis* (described below), both as to the nature and size of the interparietal and in the color pattern.

Eumeces skiltonianus utahensis, n. subsp.
Great Basin Skink

Type: Brigham Young University No. 6945, an adult female, collected at the southeastern edge of Cedar Valley, approximately one half mile directly west of Chimney Rock, Utah County, Utah, on June 10, 1944, by Wilmer W. Tanner.

Diagnosis: Differing from the typical *skiltonianus* in having a dorsolateral stripe much wider and occupying more than half of second scale row, usually varying from three-fifths to as much as five-sixths of scale row near middle of body. Diameter of dorsolateral stripe equal to approximately half of dorsal interspace. Lateral stripe in adults blended with ventral color and without a dark stripe below it. First nuchal usually larger than the second, often equal or smaller, always shorter than the width of the dorsolateral stripe.

Description of type: Rostral as seen from above equal to approximately half the length of frontonasal; supranasals large, one and one half times as long as wide, in contact laterally with anterior loreals, barely failing to contact frontal; prefrontals moderate, each nearly as large as the frontonasal, in narrow contact medially, about

equally in contact with frontal and frontonasal. Frotnal normal, approximately one-fifth longer than its distance to snout, in contact on each side, with three supraoculars; frontoparietals subrectangular, smaller than prefrontals, median suture distinctly less than half their length; interparietal with a triangular anterior and wedge-shaped posterior, not enclosed by parietals; parietals large, contacting primary temporals on left side. Two pairs of nuchals, anterior pair as long but not as wide as posterior pair. Secondary temporals large, lower plate extending posterior to eighth supralabial; upper tertiary temporal larger than lower one; and nearly as wide as first nuchal, lower scale in contact with upper postlabial, separated from ear by one small scale; ear with three lobules, median largest.

Supralabials 8-8, separated from ear by two small postlabials. Infralabials 6-6, mental wider than rostral, postmental divided, followed by three progressively larger chinshields and an elongate postgenial.

Body scales in parallel rows, median dorsal rows only slightly wider than second or adjacent rows; 60 dorsals; 44 ventrals; 26 rows around middle of body; 14 rows around base of tail; ventral tail scales enlarged, 69 in series; (tail appears to have been broken twice and regenerated).

Body scales on sides of neck and above front legs with one or two small, often very faint, pits; if two pits, close together and always near median posterior margin of scale; all other body scales smooth.

Dorsolateral lines originating on the prefrontals, and anterior loreals, rather obscure anterior to posterior supraoculars; line extending posteriorly across parietals and nuchals to second scale row and mesial tips of third row. Dorsolateral line occupies almost all (four-fifths to nine-tenths), of second row, and caudad to ninth dorsal scale, at least three fifths of third row; dorsolaterad line and dorsal interspace extending only three or four scales on to tail before becoming obscure. Width of dorsolateral line equal to approximately half of width of middorsal dark stripe and wider than length of first nuchal. A series of dark brownish spots bordering middorsal stripe on mesial edge of the scales of second row; anteriorly these spots, are close together forming a triangle or mesial corner of each scale; posteriorly becoming more rounded and father apart, appearing as small spots occupying posterior margin of scale. Center of dark dorsal stripe much lighter than margins, posterior part only slightly darker than dorsolateral stripes; an irregular series of dark spots on mid-posterior margin of most of scales of both dorsal rows produces two irregular and broken dark stripes.

Lateral line originating on fifth supralabial and extending caudad passing through ear, and extending caudad along sixth and seventh rows, becoming obscure for most of distance between legs in some adults. Space between dorsolateral and lateral stripes uniform brown except for an occasional irregular lighter spot, less than

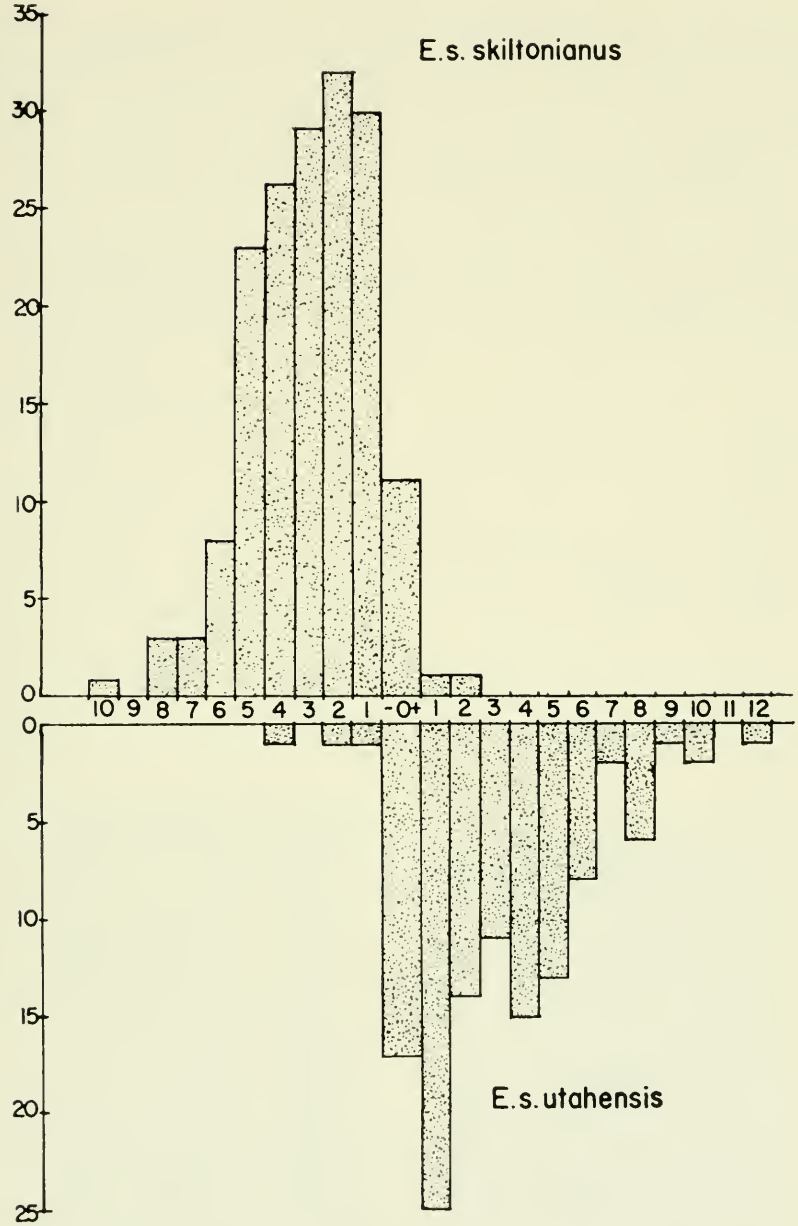

Plate 2. Histogram comparing in millimeters the length of the first nuchal minus the width of the dorsolateral stripe. A long nuchal and a narrow stripe produces the negative value in *skiltonianus*.

twice the diameter of dorsolateral stripe; dark lateral stripe extending caudad from posterior loreal; no narrow dark stripe below lateral line. Dorsal head plates brown with a few darker brown spots on sutures of some plates. Tail grayish with an infusion of greenish-blue near base of each scale; ventral plates cream colored on throat, becoming darker on venter.

Variations in Scalation: Head plates normal for the species except for the following: supralabials more often 7-8 or 8-8 (plate 3); interparietal always dividing parietals. Dorsal scale rows only slightly larger than adjacent rows; anterior nuchals usually but not always larger than posterior nuchals; dorsals, 54-63 (average 59.4), ventrals 40-47 (average 43.2). Scale rows 23-26 (average 25); total dorsal-ventral scales 96-109 (average 102.6).

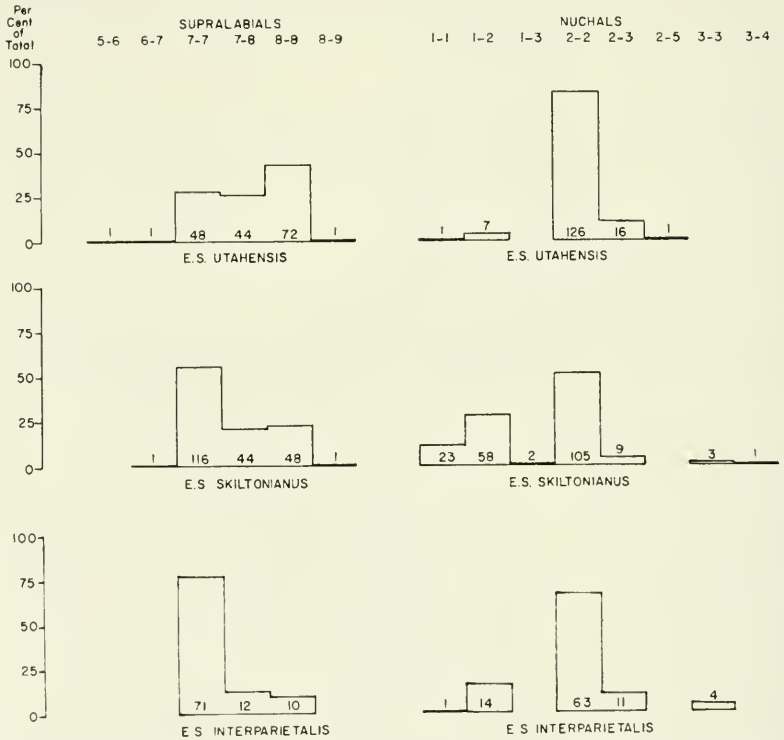

Plate 3. Histograms comparing the numbers of supralabials and nuchals in the subspecies of *Eumeces skiltonianus.*

Color pattern: Dorsolateral line originating on the supranasals or the lateral edge of frontonasal and anterior loreal in young and subadults, obscure in some adults anterior to supraoculars, extending caudad across the edges of the supraoculars, parietal and onto second and third scale rows All but mesial edge of each scale of second row

(usually three fifths to four fifths) in dorsolateral line, and caudad to 9th scale from the parietal one half to three fourths of third row in the dorsolateral line, only occasionally as little as half of either row. Dorsolateral lines extending only 4 to 19 scale lengths on to tail of adults and rarely more than 7 to 12 scales before blending with blue in younger age groups. In adult these lines are frequently difficult to trace beyond base of tail. Dorsolateral lines or dorsal interspace rarely extending caudad to foot when legs are adpressed against tail.

Each dorsolateral line equaling approximately half of dorsal interspace. Two irregular lines of dark dots on middorsal rows extending from nuchals to base of tail in a few specimens. When present each dot is located near middle of scale and extending to its posterior edge. In most specimens dorsal interspace inside of lateral border is nearly uniform in color.

Lateral line extending caudad from middle of ear to above front leg, involving part or all of both 6th and 7th rows; in juveniles and subadults this line is visible from ear to tail; in a few adults it is traced with difficulty beyond front leg. Anterior to front leg a slightly darker strip below lateral line separating ventral color and lateral stripe. In adults, ventral color blending with lateral stripe and in many adults obscuring it between legs. Customary dark stripe below lateral line, in *skiltonianus*, is absent in most *utahensis*, or with only a faint or irregular stripe.

Tail in young, Marine to Spectrum Blue (Ridgeway 1912), in young adults less intensive and becoming faded or grayish-blue. Older adults with drab colored tails, usually grayish with flecks of greenish-blue or at times with a faint tinge of salmon; ventral scales

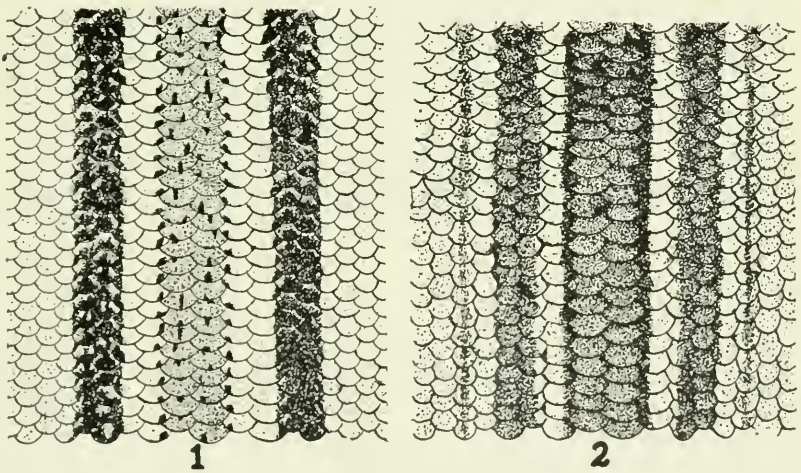

Plate 4. *Eumeces skiltonianus*: A - Dorsal pattern of *utahensis* type; B - Dorsal pattern of an Oregon specimen of *skiltonianus* (BYU 11550), 3X.

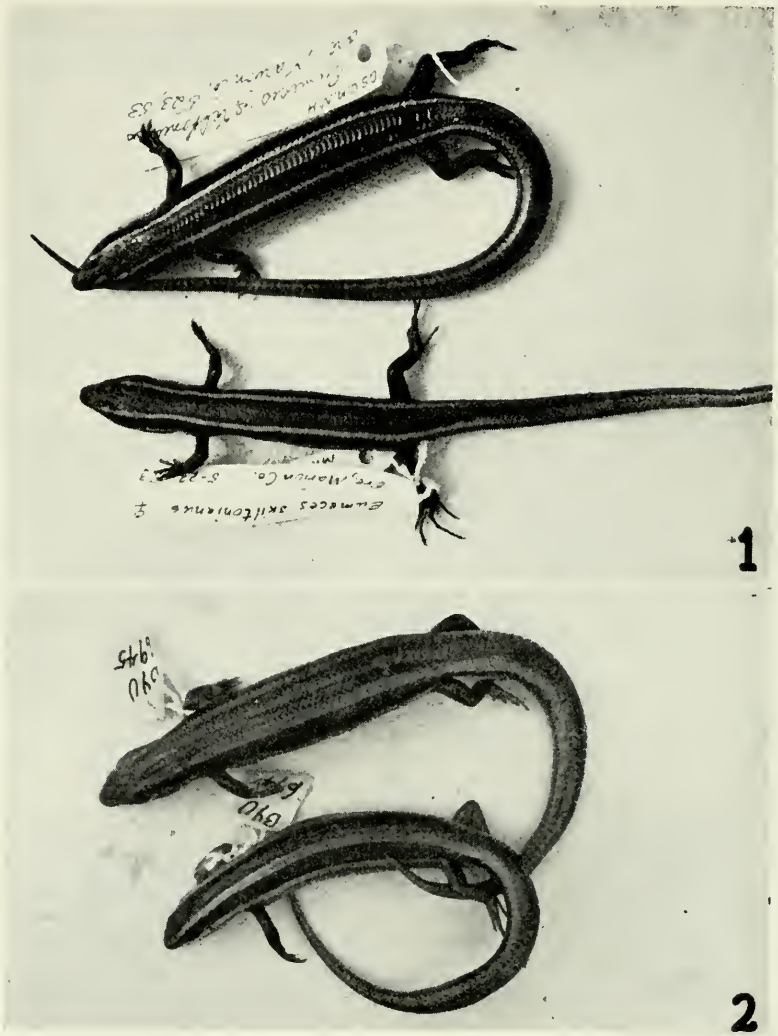

Plate 5. *Eumeces skiltonianus.* 1 - *skiltonianus* from Oregon; 2 - *utahensis,* type and paratype.

grayish tinged with bluish-green; gulars and labials of adult males pink to red; more obvious in spring and early summer. (A series taken May 18, 1957, at West Canyon. Utah County had a Light Coral Red on gulars and labials.)

Range: Southern Idaho, Nevada except the western edge from Lake Tahoe north, Great Basin in Utah, the drainage basins of the Virgin River and Kanab Creek, and Kaibab Plateau of southern Utah and northern Arizona.

Paratypes: Total 69 as follows: *Juab Co.*, Cherry Creek (BYU 9067). *Tooele Co.*, Government Creek (BYU 11969); Foust Canyon (UU 1671); 5 mi. N of Ibapah (UU 2637). *Utah Co.*, topotype (BYU 6946, 10402, 11970); West Canyon, north end of Cedar Valley (BYU 2217-39, 2292-3, 2849-50, 12652-9, 13133-8, 13738-51); Cedar Valley (BYU 537, 2099); Mercur Canyon (BYU 12651); Diamond Fork Canyon (BYU 2780); Spanish Fork Canyon (BYU 536, 1795-6).

Other Material: Total 126 as follows:

ARIZONA: *Coconino Co.*, Bright Angel Point north Rim Grand Canyon (BYU 11532, GCNP 367 and R 3737); 5 mi. E of Jacobs Lake (BYU 13142).

IDAHO: *Bannock Co.*: Lava Hot Springs (BYU 11645); Pocatello (KU 8258). *Brigham Co.*, (UU 201); *Cassia Co.*, between Malta and Idahome (MMZ 107240). *Ada Co.*, 5 mile Creek E of Boise (ISM 90). *Boise Co.*, Stack Rock (ISM 89). *Jerome Co.*, Jerome (AMNH 57697).

NEVADA: *Clark Co.*, Indian Springs Ranch, Pintwater Range (MMZ 90710). *Elko Co.*, 2 mi. N of Jarbridge (UN 210); W side of Ruby Mts. (KU 23363). *Eureka Co.*, Cortez Range W of Carlin (MMZ 43872-5). *Lincoln Co.*, Pioche (BYU 533). *Nye Co.*, Eden Creek Mine, Kawich Range (UN 3433-6). *White Pine Co.*, Canyon of Nigger Creek, Snake Mountains (UN 3555); Cleve Creek, Spring Valley (UN 3556); Lehman Caves, National Monument (BYU 13753-5); Lund (UN 4027).

UTAH: *Beaver Co.*, 12 mi. N of Beaver along Highway 91 (BYU 12661-4, 12705-6, 12725-6); Milford (BYU 535); Sulphurdale (BYU 8736). *Box Elder Co.*, 1 mi. W of Rosette (UU 2652). *Duchesne Co.*, Strawberry River, 2 mi. E of Timber Canyon (BYU 13782). *Kane Co.*, 22 mi. S of Alton (BYU 11625); 5 mi. N of Glendale (BYU 11541-8, 11551); 4 mi. N of Glendale (BYU 12667-75); Orderville (DC 227). *Piute Co.*, near Circleville (UU 1326). *Salt Lake Co.*, E of Salt Lake City (UU 361). *Sanpete Co.*, Ephriam (UU 189). *Sevier Co.*, 9 mi. SE of Sigurd (BYU 11639-42, 11759-60); .3 mi. E of Sevier-Millard line on Highway 13 (BYU 12660). *Summit Co.*, Peoa (BYU 648). *Washington Co.*, Pine Valley (BYU 650, 11549, 11743-52, 11968, DC 3, 111-5, 155, 169 a & b, 239 and 8 unnumbered specimens, 4 specimens from student collections (unnumbered RH two specimens); Pinto (BYU 10540); Mill Creek, Belveve (AMNH 22878-80); Dameron Valley (DC) (two specimens); Beaver Dam Summit (DC); Castle Cliff (DC); Water Cress Springs (DC) (two specimens); St. George (DC 235); Zion National Park (BYU 532, 647, 1797, 8763, 11972, DC unnumbered).

Eumeces skiltonianus interparietalis, n. subsp.
Coronado Island Skink

Type: California Academy of Sciences No. 13576, an adult male, collected on South Coronado Island, Baja California, Mexico, 7 April 1908, by Rollo Beck.

Diagnosis: This form is most closely related to typical *skiltonianus* with which it intergrades in San Diego and Riverside counties California. It is different to all other *skiltonianus* in having the interparietal reduced in size and enclosed posteriorly by the parietals, the median and lateral dark stripes extend from the body to or beyond the middle of the tail.

Description of type: Anterior and dorsal head plates normal for the species except for the following: interparietal reduced and enclosed posteriorly by enlarged parietals; nuchals 2-2, first noticeably larger and longer than width of dorsolateral stripe; supralabials

7-7, seventh largest; infralabials 6-6; one postlabial, separated from ear by a row of small scales; scale rows at middle of body 26, at base of tail 16; dorsals 60; ventrals 40; snout to vent 69.5 mm. total length 180 mm., ratio tail into total length 1.63.

Dorsolateral light stripe originating on the supranasals, faint anteriorly, but distinct from supraoculars posteriorly across the parietals, nuchals, and onto second and third scale rows. Dorsolateral stripe occupying slightly more than one half of second and third rows on body and for a short distance on tail; median and lateral dark stripes distinct and margined laterally by a darker brown stripe; and with these stripes extending beyond middle of tail; lateral light stripes distinct and margined ventrally by a row of brownish scales; ventral scales light olive, becoming lighter on throat.

Variations in Scalation and Color Pattern: Head plates normal for the species except for the following: supralabials usually 7-7, seventh largest, one or two postlabials, primary temporal usually in contact with lower secondary temporal, in a few specimens (CAS 13422, 55802, 57043) the upper secondary temporal is in narrow contact with the seventh supralabial; nuchals usually 2-2 (plate 3), first always largest and with a length equal to or greater than diameter of dorsolateral stripe near middle of body; scales in 24 or 26 rows; dorsals 52-61; ventrals 40-43; total dorsoventrals 92-103, average 99.3. Largest specimen examined 69.5 mm. snout to vent.

Dorsolateral and lateral light stripes distinct in adults; dorsolateral stripe occupying approximately one half of each of second ond third scale rows; median and lateral dark stripes of approximately same color and with the centers a lighter brown than margins, dark margins continuous, not broken up into small marginal spots as in some *skiltonianus* and most *utahensis*. Tail in young blue, in subadults and adults with dark stripes extending from the body to at least its middle.

Remarks: The extension of the striped pattern onto the tail is also seen in specimens of *skiltonianus* from the coastal ranges of California. However, specimens from north of San Diego County are generally less obviously striped on the tail and if so then with only an occasional one having the interparietal enclosed.

Specimens from the coastal ranges, and seemingly in the coastal environment have retained as adults, more pigment in the median and lateral stripes than occurs in the adults of other population of the species. This was first noted by Rodgers and Fitch (1947:196) in specimens from Northern Baja California and from San Diego, Ventura, Monterey, Sonoma and Mendocino Counties, California. Melanistic skinks undoubtedly occur further north and may explain why Cope (1898:643) described the variety *amblygrammus* from Humboldt County.

Range: North and western Baja California including the Coronado and Todos Santos Islands, and southern San Diego County, California.

Specimens Examined: A total of 124 as follows:

MEXICO. *Baja California*, South Coronado Island (CAS 13560-1, 13563-6, 13570, 13572-5, 13577; LMK 4813-4, 20072-3; MVZ 51197-51207, 5400); East Coronado Island (CAS 13462-7, 13470, and AMNH 5186); North Coronado Island (CAS 53953; AMNH 22721; USNM 52412, 75082, MVZ 64609-11, and 16716); Coronado Islands (CAS 13595-600 and USNM 64410); North Todos Santos Lsland (CAS 56841-2); South Todos Santos Island (CAS 5636-8, 56840 and SU 12107); Todos Santos Islands (USNM 37686 and MVZ 10487-9, 51191-6); San Pedro Mts. (USNM 23723); La Grulla (MVZ 9803 and 51118); San Jose (CAS 65812-4, MVZ 9654 and LMK 24402-3 and 5099); 6 mi. SE of Cape Colnett (CAS 57556); Ensenada (CAS 13422), 17 mi. N of Ensenada (MVZ 63504); Arroyo Ensenada (CAS 57043-4); San Quentin (CAS 55802); Alcatraz (CAS 57331); La Encantada (LMK 6101).

CALIFORNIA: *San Diego Co.*: Barona Ranch Alpine (KU 8794-5); (LMK 28628); Dulzura (SU 5239); El Capitan (LMK 21211 and 21215); Laguna Mts. (LMK 27095 and 27097); San Diego (LMK 28329, KU 113-4708); Palomar Mts. (KU 7306-10, MMZ 67361); Intergrades *skiltonianus x interparietalis; San Diego Co.*: Escondido (WSC 47-47); Oceanside (BYU 8335-8, 8719-25); Poway (MMZ 76865 five specimens). *Riverside Co.*: San Jacinto, (SU 21-26, 29 and 1252); Andreas Canyon S of Palm Springs (SU 11192); Snow Creek (SU 7936); Palm Springs (SU 11658).

Eumeces lagunensis Van Denburgh
San Lucan Skink

Eumeces lagunensis Van Denburgh, Proc. Cal. Acad. Sci. (2), V. 1895: 134, pl. XIII (type locality, San Francisquito, Sierra Laguna, Lower California, Mexico); Taylor, University Kans. Sci. Bull. 1935, 23:431-437.

Plestiodon lagunensis Van Denburgh and Slevin, Proc. Cal. Acad. Sci., Ser. 4, 1921, XI; 52; Van Denburgh, Occ. Papers Cal. Acad. X, 1922; 1:587-589.

Plestiodon skiltonianus lagunensis Nelson, Mem. Nat. Acad. Sci., 1921, XVI:114-115.

Eumeces skiltonianus Loveridge, Copeia 1930:111-112.

Eumeces skilonianus lagunensis Linsdale, Univ. Cal. Publ. in Zool. 1932, 38:374.

Range: In the southern third of the peninsula of lower California, from the Sierra de La Laguna north to Comondú.

Diagnosis: A member of the *skiltonianus* group but differing from *skiltonianus* in the following characters: seventh labial much enlarged, often nearly twice that of sixth labial; primary temporal reduced in size and separated from smaller, lower, secondary temporal by a broad contact between upper secondary temporal and seventh supralabial; interparietal reduced in size and enclosed posteriorly by parietals; usually 2-2 nuchals, first noticeably larger than the second; two lateral and two dorsolateral light stripes as in *skiltonianus*, all retained in adults; tail of young pink.

Description of the species: For a detailed description of this species, see Van Denburgh (1922) and Taylor (1935). The present description is brief, but is, because of the increased number of specimens available, given as a supplement to previous descriptions: Scale rows around middle of body 24; dorsals 57-(58.2)-60; ventrals 40-(42.1)-46; nuchals 2-2, occasionally 1-1, 1-2, or 3-3; first nuchal larger than second and its length equal to or greater than diameter of dorsolateral stripe; dorsolateral stripe on one half of second scale row; interparietal reduced and enclosed posteriorly by parietals.

primary temporal reduced in size and separated from lower secondary temporal by a broad contact of seventh supralabial and upper secondary temporal; postlabial single or double and separated from ear by one or two rows of small scales; lamellae fourth finger. 10-(11.1)-13, fourth toe 13-(15)-16; adpressed legs overlap in juveniles usually not in adults.

Color patern distinct in adults; dorsolateral stripes edged with a dark brown, darker in juveniles and becoming lighter in adults; lateral stripe usually with a dark ventral margin; tail of young pink, becoming olive brown in adults; stripes, both dark and light, extending onto base of tail, and in a few, visible for half the length of the tail.

Remarks: Except for the broad contact between the seventh supralabial and the upper secondary temporal, and the pink tail, all other characteristics are similar to those found in *E. s. interparietalis*. It is not as yet clear whether we should retain *lagunensis* as a distinct species or regard it as a subspecies of *skiltonianus*. Several characters suggest the latter, particularly the following: reduced and posteriorly enclosed interparietal, size of nuchals, reduced number of ventrals, supralabials reduced to seven, and the color pattern of the adults which is very similar, particularly between *lagunensis* and *s. interparietalis*. The similarities indicated are of such a nature as to actually imply a north-south clinal distribution between the later two. Furthermore, there are a few specimens of *s. interparietalis* in which the seventh supralabial and the upper secondary temporal are in narrow contact, however, not a single *skiltonianus* has been seen which would approach *lagunensis* in the broadness of this contact.

In the single young specimen which I have seen with the tail still pink (SU 19119), there is no evidence of blue having been present. Although it may be that we have some supspecies in *Eumeces skiltonianus* with blue tails and some with pink tails, as in *Eumeces gilberti*, this has not as yet been shown to be the case. There is a rather large area, between Comondú and approximately thirty degrees north latitude, from which material is not available. In as much as there are still some doubts concerning the true relationship of this skink, it is considered best to continue to recognize *lagunensis* as a distinct species.

Specimens examined: A total of 16 as follows:

MEXICO: *Baja California*: La Laguna, Sierra de La Laguna (SU 19119). Comondú (CNHM 25837-44, and MVZ 13760), trail between Loreto and Comondú (USNM 67398-403).

Ecology and Life History

The following observations have been made during the past fifteen years and are concerned primarily with the Great Basin Skink. Other subspecies of this species have not been carefully studies as yet, although it is suspected that much of the data presented below will be applicable to all segments of the species.

Habitat: Although *skiltonianus* has a wide distribution its habitat is restricted primarily to the scrub oak, sage brush and open grassy slopes in the Upper Sonoran, Transition and the lower part of the Canadian Life zones. One is not likely to find this skink in heavy brush; rather they occur in the open areas usually the rocky ridges or other small openings where shelter is present. However, brushy areas adjoining open rocky habitats are often used for foraging. They do not appear to inhabit lower valleys where deep soils or sands occur. In the Great Basin the alkaline valleys are uninhabited by skinks. As soon, however, as the rocky slopes bearing *Artemisia tridentata* or *Juniperus utahensis* are reached one may encounter skinks. I have been most successful while collecting in rocky areas in which oak brush (*Quercus gambellii* Nutt) forms a loose vegetative cover in association with sage, grasses and juniper. Such a habitat in the Great Basin occurs at an elevation of approximately 4500 to 7000 feet, although specimens have been taken at lower elevations in Washington County, Utah. Elevation is not the important factor in determining distribution since favorable habiats at much lower elevations in the coastal regions are ideal. Apparently rainfall sufficient to provide suitable vegetative cover and physical conditions which will provide loose rock for cover and soil for burrowing and nesting determine in general, the occurrence of these lizards. According to Rodgers and Fitch (1947:174), *skiltonianus* in the Great Basin "is spotty in occurrence and is restricted to the cooler, higher areas of certain mountain ranges." Such is undoubtedly true for the broken and isolated block ranges of Nevada and western Utah. However, along the central uplands of southern Idaho, Utah and northern Arizona the range of *skiltonianus* is nearly continuous as in the coastal regions, and not necessarily restricted to higher areas.

A specific area of habitat (plate 6) in northwestern Utah Co. indicates the type of vegetative cover which seemingly provides a near optimum habitat for this species. The photo was taken approximately fifty yards up the canyon from the nesting habitat described by me in 1939. The latter is now grown up with a heavy cover of sage brush leaving only small open areas and covering or shading the rocks previously used for shelter and nesting. Although some time was spent looking for skinks in the very same area where they were numerous in 1939, only one was found. This is in contrast to the five nesting females and seven other males and females found in 1939. From the marginal area, part of which is shown in fig. 1, my wife and I collected thirteen skinks: seven gravid females, three adult males and three juveniles. Since the adjoining area is of approximately the same size it is obvious that the western skink prefers a habitat with some open rocky patches, some shade, but not heavy brush. Concentrated skink populations have been found in many places throughout Utah and on a small open ridge 29 miles west of Red Bluff, California.

Such habitats tend to support a rather uniform population as

suggested by the population counts. However, some excepions have been found and will be indicated below.

In Oregon Fitch (1936:634) found skinks of the Rogue River area to sometimes occur in concentrated colonies in rocky open places in the forest. Skinks were seemingly common on grassy hillsides and in pastures which were strewn with flat rocks. On the basis of catalog entries made for skinks in western Oregon, Robert M. Storm indicates a rather wide use of decaying fir logs, with many being found by removing loose bark.

Habits and Behavior: Most skinks are secretive in habit and are usually not seen unless disturbed by turning stones or other types of cover. This is particularly true of *skiltonianus*, a form rarely seen abroad, although there are evidences to suppor a belief that they are commonly out foraging during the day. Their ability to escape detection is attested to by the rarity of their observation by people living in their habitat. Sportsmen and ranchers see them rarely or not at all. In more than ten years of field observation during which a considerable number of hours have been spent in areas inhabited by western skinks only seven animals have been seen abroad; three were adult males, two adult females, one sub-adult and one a juvenile less than a year old. Quite in contrast to the suggestion of Stebbins (1954:281), four were seen between 10 a.m. and noon, one, a female, was seen between 2 and 3 p.m. When collecting, one occasionally finds a skink under a loose rock or between rocks where there is no sign of burrowing. In a few instances such animals have, when disturbed, returned to their burrows under a nearby rock. These animals were undoubtedly foraging, and had used any nearby shelted for a temporary hiding place. Records concerning skinks found under rocks in which a tunnel was not found were only recently kept.

Dr. Stephen L. Wood has recently related to me his observation of this lizard, while vacationing at the Lehman Caves National Monument in eastern Nevada. His observations were made during July and the first of August in 1939. By quietly sitting on the steps of the ranger's cabin, skinks could be observed while foraging. If the observer remained quiet, close observation over a relatively long period of time was possible.

The habitat consisted of a rock wall on the downhill side of the trail leading away from the cabin steps and a few loose rocks along the foundation of the cabin. Within a relatively small area in front of the cabin as many as three adults were seen abroad at one time. After the first of August, a clutch of five young ones appeared and were often observed on the lower steps.

Dr. Wood assured me that his observations were made between the hours of 10—12 a.m. and again in the late afternoon between 5 and 7 p.m. Skinks were seldom seen during the warmer hours of the day and then only in shaded areas. These data plus the few lizards seen abroad indicate that *E. skiltonianus* may forage throughout

the day, but with a preference during the summer for the warming morning and cooling afternoon hours.

Linsdale (1938:29) reports a similar experience for the Toyabe region of southcentral Nevada. "On the afternoon of June 18, 1931, a skink came into the house at Mohawk R.S. It was frightened and ran quickly down a hole in the floor. On June 21, between 9 a.m. and noon, five skinks were shot and at least one other was seen, all within 15 feet of the northeast corner of this house. They were active along the east side of the house and along the base of an adjacent rock wall. On July 6, 1931, along North Twin River, 6500 feet, a skink was seen, but not captured, in midafternoon in leaf litter on rocky ground beside a trail in the bottom of the cañon."

Grinnell, Dixon and Linsdale (1930:148) report having seen one on a rock in a tumbled-down rock fence. The fence bordered an open, grassy pasture (April 27). On June 22, two western skinks were seen, momentarily before taking cover beneath large rotting logs. The latter was at mid-day on the floor of an open woods among black oaks, yellow pines, and incense cedars.

Zweifel (1952:9-10) found this species to be out foraging throughout the day but particularly so on days when the sun was obscured by high fog.

Caged specimens observed in the laboratory were active throughout the day, but were invariably under cover at night. Lizards placed in gallon jars with only a thin layer of loose soil were surprisingly capable of working themselves into the soil and gaining complete or partial cover. I have returned to the laboratory at night on many occasions and found them in hiding if cover was available.

The western skink is usually adept at burrowing in the loose soil of a rocky hillside. Burrows are nearly always made by tunneling along the side of a rock or if the slope is steep, under the rock from the lower side. Usually the tunnel terminates on the uphill side of the rock, often a few inches in the soil from the rock. Such is typical for females and most males, although in a few instances the tunnels of the latter have been found in rocky soil where they descend for eight to ten inches below the surface and are as much as fifteen to eighteen inches long. A few burrows have been found under prostrate sage or oak brush limbs. In such cases the tunnel runways extended into the roots of the sage or the base of the oak trunk. By far the greater number of burrows found in the areas studied have been associated with rock.

Tunnels dug by males average longer and are smaller in diameter, often being only slightly larger than the diameter of a pencil. Female burrows are shorter and terminate in enlarged chambers, which serve as "nests" during the incubation of eggs (Tanner, 1943:83). Such chambers may be three to four times the horizontal diameter of the skink, and provide considerable room for movement. The terminus of male burrows provides barely enough room for turning around. One burrow was terminated by making a loop around a small rock.

When foraging, this skink moves slowly and with a somewhat jerky motion. Observations indicate that they are quiet, making very little noise unless disturbed. Stebbins (1954:281) suggests that "When moving rapidly to escape capture, they progress largely by snakelike undulations of the body." This wriggling tail and snakelike undulating body may appear to unsuspecting observers to be their main method of movement, however, when deprived of the usefulness of their legs, they are immobilized. Observations indicate that the use of snakelike body undulations occur primarily when they are surprised while feeding, suddenly disturbed by turning a rock, or when attempting to escape immediate capture. Skinks seen in the open and those permitted to escape move with very little body undulaion or tail wriggling. Tail wriggling is more in evidence in juveniles and subadults. This is because of the long bright blue tail, which is made the most conspicuous part of the animal as it attempts to make its escape. Beginning students are often fooled by this habit and secure not the skink but only the wriggling tail. Meanwhile the less conspicuous animal has often found shelter and is saved. The older females and males with their more drab colored tails do not attract the same attention and actually do not appear to provide as much tail wriggling as do the juveniles. It has been suggested by others (Jopson 1938:90 and Stebbins, [Zweifel] 1954:283) that the blue tail and the habit of wriggling it has a survival value for skinks in general as well as for the western skinks. Whether native predators are attracted by the blue color and/or by the wriggling tail, as the case with many collectors, is still only surmised.

Feeding Habits: Data gathered previously (Tanner 1943:87) and that of recent years indicate the food of these lizards to consist almost entirely of insects. An occasional spider, centepede or sow bug is also taken. According to Zweifel (loc. cit.) they are occasionally cannibalistic. I have not observed this in the Great Basin Skink in nature nor in captivity. Caged specimens of various sizes and ages have been kept together for as long as three weeks without food and yet gave no indication of cannibalism. Small *Sceloporus* and *Uta* have also been unharmed.

Observations made during the beginning of the study had so impressed me with the apparent secretive methods employed by this species that I had suspected much of their feeding to occur in sheltered or covered areas. There inherent shyness, which compel them to remain close to the shelter of bushes, grass and rock, rarely being so bold as to venture over a rock or into an open area, does not prevent them from feeding on a rather wide variety of terrestrial arthropods.

While turning rocks in search of skinks I have always been impressed by the number of ant beds uncovered. Yet I have found only an occasional ant in the stomach contents of Utah skinks. Knowlton (1946) found no ants in four stomachs examined in the course of his studies of Utah lizard species feeding on ants. Taylor (1936:61), after examining the stomach contents of representatives

of this genus was surprised to find no ants although a wide variety of other anthropods were represented. Food items consist primarily of crickets, beetles, moths, grasshoppers, and other available arthropods. The following list of authors have found this species to be insectivorous and have indicated the following items of food: Van Denburgh (1922:583) states the food to be insects and that plant materials come from caterpillers eaten by the lizards. Woodbury (1931:61) observed caged specimens as they fed on flies. Fitch (1936:643) kept a specimen in a terrarium for three years. Its diet consisted of cutworms, maggots, earthworms, flies and cockroaches. Ferguson (1954:151) found them to readily feed on moths and other insects.

An examination of the stomach contents of twenty-five skinks taken in Utah during the years 1955-57 is as follows: Insect eggs, click beetle larvae, several different kinds of caterpillers with much finely ground plant tissue, cutworms, moths, maggots, beetles (carabids, scarabs, and weevil), grasshoppers, crickets, spiders and one had eaten four small yellowish-brown ants.

Reproduction: It is evident from records, both published and from my own field data, that the mating season in Utah may range through May and into the first part of June. This will vary from year to year depending on the earliness of the spring and from one locality to another depending on elevation.

During the spring and summers of 1955, 1956 and 1957 several series, taken at intervals, have been examined. Most have come from northwestern Utah County, although some have been seen from Beaver, Kane, Sevier and Washington Counties, Utah. By the first of May at least two or three weeks after emergence from hibernation, males have developed the reddish color (Light Coral Red, Ridegeway 1912) on the labials and gulars. As the season progresses the color covers a greater area and becomes more intense. At this time all adult males (two year old) can be distinguished from the females and from the subadult males (one year). The latter have the same color as adult males (see above), but with less area covered and without the intense color of the adults and can be easily segregated from adults by means of gular color and by their smaller size. Furthermore, the older males are found in larger numbers during April and May than at any other time. The finding of a male and female under the same rock is not uncommon in May, it has not been observed during July, August or September.

The seasonal change in the size and appearance of the testes also indicate that the mating season occurs principally during May. Actually the increase in size of the testes corresponds very closely to the increase in the labial and gular red color with both reaching their maximum size and intensity at approximately the mating season. Table 1 indicates the size of testes during and after the breeding season.

Unfortunately only one probable field record is available of mating in this species. A pair was observed in apparent copulation

on May 18, 1957. When first seen, the male was laying along the side of the female and with the posterior part of the body and tail curved under the female. They were discovered in an expanded cavity under a large flat rock. Both remained motionless for approximately 10 seconds after which both scurried for cover. The above record should not imply that mating in this species occurs only under cover. This species is apparently an active forager throughout most of the day during the spring when mating occurs. There is no reason to suspect that mating does not occur while they are abroad.

In the females, at the time of emergence from hibernation, the ovaries are filled with many small, but differently sized eggs. At this early date it is difficult to determine which eggs will actually develop or even those which may be potential. In some, a single ovary may contain 15 to 23 eggs ranging in size from .1 mm to 1.0 mm. In general they appear very much like those examined in females taken in late August and September. The larger eggs measure

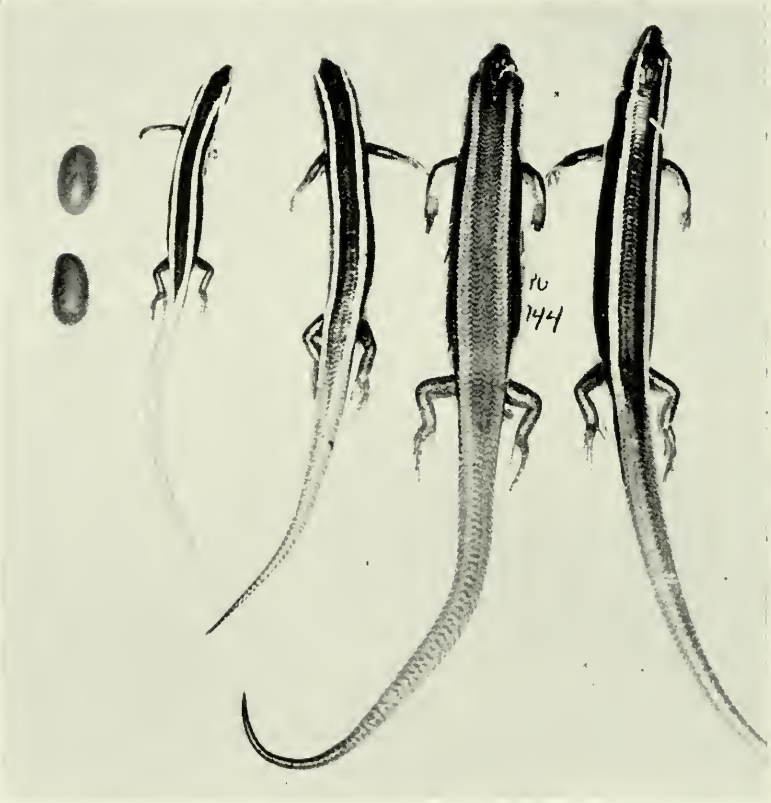

Plate 6. Age groups of *Eumeces s. utahensis* as they occur in late April or early May. Eggs are day old, layed July 11, 1957.

TABLE 1

Fluctuations in the sizes of testes from April to August in Adults of the Great Basin Skink.

Date	Museum Number	Length of Testes	Width of Testes	Snout to Vent	Approx. Age
27 Apr. 55	12468	6.5	3.7	67.6	Adult
27 Apr. 55	12476	6.8	3.1	64.0	Adult
27 Apr. 55	12473	7.6	3.5	60.1	Adult
27 Apr. 55	12474	6.4	3.5	58.8	Young Adult
2 May 56	13137	6.7	2.7	57.8	Young Adult
7 May 52	11545	7.0	3.4	62.0	Adult
10 May 52	11551	5.8	3.5	63.0	Adult
18 May 57	13744	7.2	3.9	64.0	Adult
18 May 57	13745	6.8	3.8	68.1	Adult
18 May 57	13746	7.0	3.8	60.5	Adult
18 May 57	13747	6.1	3.5	58.3	Young Adult
18 May 57	13749	6.7	3.5	62.9	Adult
25 June 57	13751	4.1	1.9	58.6	Young Adult
28 June 57	13756	4.7	2.7	64.0	Adult
28 June 57	13758	4.6	2.4	65.5	Adult
28 June 57	13761	4.5	2.0	62.8	Adult
4 Aug. 39	2237	4.5	2.3	61	Adult
23 Aug. 55	12671	5.4	2.7	65.2	Adult

TABLE 2

The numbers of potential eggs from early to late ovarian development.

Development Stage	Number of Potential eggs	Size of eggs max.	Size of eggs min.	Snout to Vent	Date	Museum Number
Early Ovarian	7 11	1.3	0.7	61.0	1 Jan. 47	8719
Early Ovarian	5 6	1.0	0.6	70.0	26 Apr. 52	11550
Early Ovarian	4 4	2.5	2.2	70.3	18 Apr. 53	11970
Early Ovarian	3 5	1.5	1.0	59.0	4 May 53	11968
Early Ovarian	6 5	1.6	1.0	65.0	5 May 53	11549
Early Ovarian	4 4	2.7	1.4	68.0	7 May 52	11541
Early Ovarian	4 6	2.5	1.2	64.0	7 May 52	11542
Early Ovarian	6 7	2.1	0.9	64.0	7 May 52	11543
Early Ovarian	3 4	3.0	2.1	62.0	14 May 54	11760
Early Ovarian	5 5	1.1	0.7	60.4	27 Apr. 55	12472
Early Ovarian	5 5	2.0	1.1	70.5	18 May 57	13753
Early Ovarian	4 4	2.4	1.6	66.4	18 May 57	13748
Early Ovarian	5 6	2.0	1.3	69.2	18 May 57	13766
Middle Ovarian	2 4	5.3	2.2	65.0	18 May 57	13750
Middle Ovarian	2 4	3.8	2.4	65.2	20 May 55	12639
Late Ovarian	3 3	8.6	7.3	65.5	6 June 52	11743
Late Ovarian	2 3	11.6	9.8	67.1	6 June 52	11744
Late Ovarian	2 2	9.6	8.2	61.5	6 June 52	11745
Late Ovarian	1 3	10.1	7.5	66.7	27 June 57	13762
Late Ovarian	2 3	10.0	8.2	63.5	27 June 57	13757
Late Ovarian	0 3	7.2	5.5	65.4	27 June 57	13759
Late Ovarian	2 3	10.0	8.5	62.2	27 June 57	13763
Late Ovarian	2 2	10.5	7.8	66.0	27 June 57	13764
Late Ovarian	2 2	13.7	11.1	57.5	2 July 55	12652

approximately 2.0 mm. in early May. By the middle of May the larger ones may measure 5-6 mm. This growth continues until the eggs are from 12 to 14 mm. long at which time they are layed. Egg laying occurs usually during the first two weeks of July in Utah.

According to Stebbins (1954:283) skinks taken in the vicinity of Berkeley, California contained from 7 to 10 eggs ranging in size from 2 to 6 mm. in diameter. Unfortunately, dates were not given. However, these figures correspond very closely with the development I have observed in Utah during the first two weeks of May. The normal occurrence of 7 to 10 eggs in the ovaries at this early date is not however, indicative of the numbers actually layed. Obviously there are more eggs produced by the ovaries, and then partly developed, then can be finally produced. Most of the ovarian eggs measured (Table II) had received varying amounts of yolk. During May and June the differentiation in size becomes greater, with fewer eggs being fed yolk until by the last of June, large, yolk laden eggs have been reduced to at last six and occasionally only two. Most fmales produce 3, 4, or 5 eggs. Table II will indicate the development and size of ovarian eggs.

There is a dearth of information concerning reproduction of this species from the coastal states. Van Denburgh (1922:584) reports a clutch of five eggs found in a burrow beneath a flat rock in a rock pile. This find was at Pacific Grove, California about June 15, 1898. The eggs were far advanced in incubation and were probably witihn two weeks of hatching.

Rodgers and Memmler (1943:64) have presented some data on egg laying and hatching dates for skinks taken within two miles of Bald Peak in the Berkeley Hills of extreme western Contra Costa County, California. These data are summarized as follows: Three clutches were laid in captivity on July 5, 11, and 14. Three nests were found in the field on July 15, July 21 and on August 9. There is no indication as to the numbers of eggs in each clutch. Those found in the field on July 15 hatched on August 16, 1942.

According to Gordon (1939:71) "eggs are few in number and deposited in the ground."

Apparently egg laying may begin during the latter part of June and extends into July. Here again, the season and elevation will have a decided effect on the date. In Utah nesting activities may begin in late June but records for this are only for July and August. One female (BYU 12652) taken July 2, 1955, extruded two eggs while being caught. Apparently the pressure applied in pressing her to the ground was sufficient to force out the nearly mature eggs. There were four eggs to be layed including the two extruded ones. The largest egg measured 14 mm. long, and the smallest is 11 mm. Eggs found in the field after the fifteenth of July have measured 15 or more mm., and have increased in size until 17 or 18 mm. was reached before hatching. This increase in size results from the stretching of the pliable membranous shell when water is absorbed by the egg from the soil.

Plate 7. General habitat areas of *Eumeces skiltonianus*. Fig. 1 - General view of West Canyon area. Fig. 2 - Nesting area of 1939, now grown up with sage (*Artemisia* and *Chrysothamnus*).

It is during the mating season that skinks are most easily found and apparently most often seen abroad, since nearly all collection records are for May, June and July. In April and May, males and females can be taken in approximately equal numbers in the habitat. In late June and until September, more females are taken than males. This is based on many series taken during these months over the past

ten years. On June 28, 1957, thirteen skinks were taken from a small area; of these three were adult males (see table I), seven were gravid females and three were subadults. A series of approximately fifty adults taken in four different localities during the months of July and August is thought to be significant in as much as the ratio between females and males is approximately 2:1.

On occasional years adverse weather conditions may reduce the hatch; for example, following the drought of 1956, only a few young were seen in the spring of 1957. The young of the previous year usually represent a uniform percentage during the summer. By late July or early August the hatchlings begin to appear, their numbers increasing until the entire season's hatch is completed in middle or late August.

In a previous study (1943:83) I described several nests of this species from the north fork of West Canyon in northern Cedar Valley, Utah County, Utah. Two additional nests are described below, both coming from widely separated areas in Utah.

On August 21, 1955, 12.3 miles north of Beaver, Beaver County Utah, 100 yards west of highway 91, a nest of five eggs and the attending female were found. The largest egg measured 18 mm. and the smallest 16 mm. long. The female has a snout-vent length of 65.5 mm. The locale is on a south slope with scattered oak, service berry and junipers among the dominent sage. Occasional patches of loose rock in open areas provided the specific habitat for the skinks. The nest was found on the uphill side of a rounded rock. The rock was approximately 15' x 15' and about 8' thick. The opening to the tunnel was on the side of the rock. By dipping slightly it then extended around the rock to the nest. The opening to the nestling chamber was 3 3/4 inches below the surface and 3 inches above the floor of the hole left by the rock. Two eggs in the mouth of the chamber were clearly visible. This chamber was extended into the soil for approximately 5 inches and was slightly enlarged posteriorly. Not until the first egg was removed from the narrow opening did the female appear, nor could she be seen. Because of recent rains the soil was wet and loose, and the eggs were coated with an almost uniform layer of mud, indicating that they had been tumbled about by the adult. Whether the turning of the eggs by the attending female is a common procedure or is done accidently is not known. Air temperature was 32 degrees C., soil temperature among the eggs was 30 degrees C. One egg was broken, presumably by the female at the time of collecting. The others began hatching in the laboratory on August 26, at 10:30 a.m. At this time two heads were out. For several hours little activity was noted. In each case the young skink lay with its head out as if it were resting. At 2:00 p.m. one had left the shell. The next morning both hatchlings were chilled and measured. Snout-vent lengths were 29 and 28 mm., the total lengths were 67.5 and 65.0 mm. respectively. Both were kept in a small cage with moist towels and a small dish of water, but no food. Every few days they were measured, in all, four measurements were taken over a

period of two weeks. For the first ten days growth was observed, each lizard gaining approximately 2 mm. in their snout-vent length. Presumably there was enough yolk available to the hatchling to maintain its normal metabolism for the first 10-15 days after which normal feeding must occur. After several days the remaining two eggs were opened, one contained a dead, but apparently mature skink, the other contained a live embryo, but yet several days from hatching. It had a snout-vent length of 26 mm. and the yolk sac was not yet absorbed. In other clutches of eggs hatching was completed within 24 hours.

On August 23, 1955, at 11 a.m., 4.1 miles north of Glendale, Kane County, Utah, a nest of five recent hatchlings was found with an adult female under a large, flat, limestone rock. The locale was on a steep southeast slope, with oak and juniper as the predominant plant cover. Because of the steepness of the slope the uphill portion of the rock was covered with soil. Again the nesting chamber was at the uphill edge of the rock, and extended for approximately nine inches along the rock and from two to three inches beyond the rock into the loose moist soil. On moving the rock, the hatchlings scattered in several directions, while the female remained to run back and forth in her now exposed chamber.

Two gravid females taken in north fork of West Canyon, Oquirrh Mts., Utah Co., Utah, were placed in a cage June 27, 1957. Loose sod and rocks were placed in the cage to provide opportunities for shelter and nesting. Tables I and II give the size of eggs and testes in others taken at the same time. On July 9th one female was killed by the other while attempting to nest. One egg had been layed and was near the edge of a rock previously used by both skinks as a shelter. The scarred and twisted skin around the head and neck of the dead one indicated a rather ferocious struggle. Three eggs were still in the oviducts of the dead female. On July 11th the remaining female layed 4 eggs in a small cavity between the two rocks used for shelter and presumably where the first female had attempted to nest. The eggs were layed between 11:30 a.m. July 10th and 10:00 a.m. July 11th. The eggs measured 14.6 x 7.3; 13.1 x 7.2; 12.8 x 8.1; 12.8 x 7.9 mm. The eggs weighed 6.0, 4.6, 5.5, and 5,5 grains respectively, averaging 5.4 grains. The single egg layed by the other femals was 12.5 x 7 mm.

During the first two weeks the room temperature varied between 77° and 80° F. By removing a small cap rock the nest could be observed. For the first two weeks no perceptible changes occurred except that the eggs were moved by the female each day. On July 24, the nest had been noticeably deepened and only three eggs remained. No trace of the fourth egg could be found. By this date the eggs were preceptably larger, and measured as follows: 15.1 x 8.5 (previously this egg was 14.6 x 7.3); 13.8 x 8.2; 13.6 x 9.6. They now weighed 8.5, 10.0 and 9.8 grains respectively. The longest egg could be easily differentiated from the others and was thus observed to have increased in size by .5 x 1.2 and to have gained 4.1 grains in weight.

This was approaching twice the weight of the egg at the time of laying. The eggs were now taut and would roll on a smooth surface.

Several hours after returning the eggs to the nest, a check was made to see if the female was continuing to expand and deepen the nest. She had moved the eggs again and a second had been broken. It contained a live embryo which was well formed. The legs were

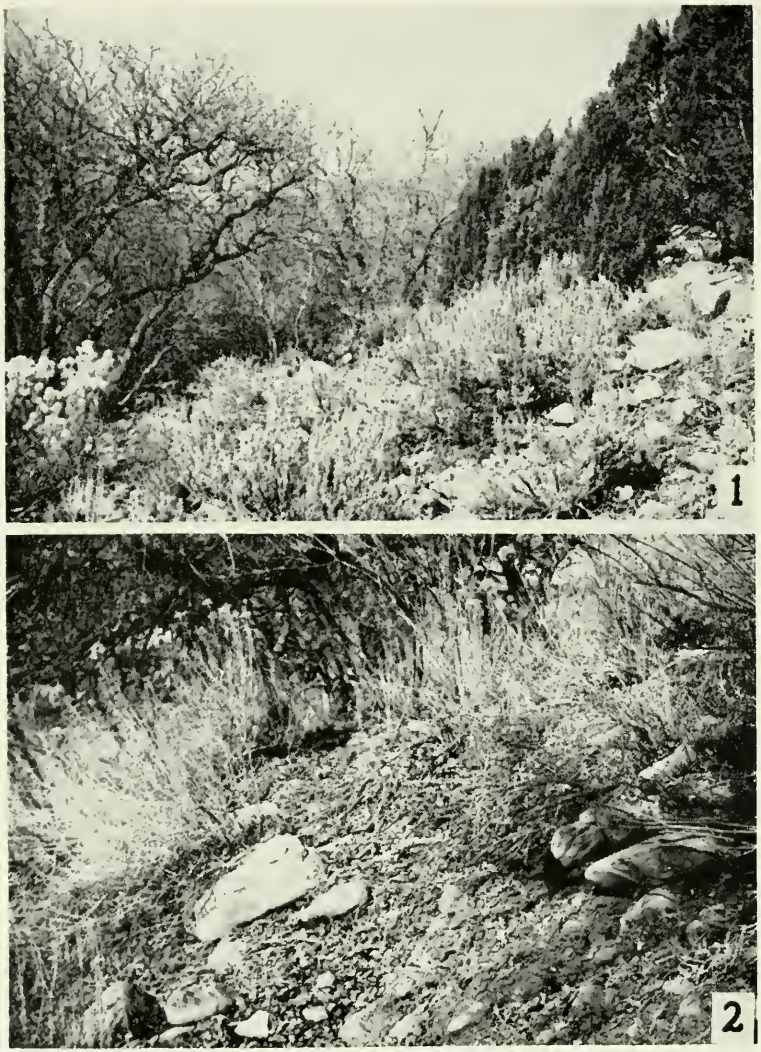

Plate 8. Specific habitats in West Canyon nesting area. Fig. 1 - Nesting area a short distance up canyon from Plate 7, Fig. 2 - where gravid females were taken June 27, 1957. Fig. 2 - rocks and brush relationships in the specific habitat.

present but with webbed toes, tail long, head large with large eyes, and with the parietal and occipital centers bulging; snout, jaws and nasal openings were well formed. The circulatory system was in evidence in the membrane of the yolk sack. Body and head scales had not yet formed.

For the first two weeks the female was relatively docile. Each day she appeared to be content to remain in the original nest with the eggs. Once she began to dig (July 24) her activities continued until all of the eggs were broken. The third on July 27, and the last on July 29.

Females disturbed while brooding their eggs vary in their response. Some remain in the nest, others dart in and out, and some desert their nest. Where it has been possible to leave the nest and return for further observations each deserted nest has been re-entered and repairs made, often resulting in considerable digging and moving of the eggs. In one case (Tanner, *op. cit.*) the female refused to leave her eggs and offeered resistance by biting a stick used to roll an egg from the nest. After several attempts, one egg was rolled a few inches away from the others and lay on the edge of the enlarged chamber. At this time the female darted out, seized the egg, bit it and returned into the nest. The egg membrane was ruptured by the bite.

On the basis of seven nests observed in the field and one in captivity it appears that all females do not occupy their nest nor brood their eggs in exactly the same manner. Two were seen to coil around the eggs, three lay along side of them, but in the posterior part of the chamber. In one, the eggs were in a nest to one side of the chamber with a slight ridge of loose soil separating them from the other part of the chamber and the female. In nests bearing recent hatchlings it was not always possible to ascertain the brooding positions; however in most cases the chambers are so constructed as to provide for the nest near the middle. In cases where the eggs were left in the nest and observed for several days after disturbing them, a reconstruction and extension of the chamber usually resulted in producing a different brooding position than was first observed. Although conclusive evidence is not yet at hand, that now available and particularly that obtained from the female in captivity, suggests a turning of the eggs and perhaps several positional changes of the eggs during the course of the incubation period.

All nesting chambers have been found under similar environmental conditions. Five nesting areas known to me are all with a south exposure in open rock areas where considerable warmth from the sun may be received. On clear days the soil for several inches below the surface is warm to the touch with a temperature on the floor of the nests of 28° C to 33° C late in the afternoon.

Field data suggests a definate tendency toward gregariousness in this species. Upon several occasions areas which appeared to be ideal were barren. Whereas an open area of similar size and type a short distance away produced a series of skinks an hours later, often

with less effort. As indicated by Fitch (1936), there is a fluctuation in population densities from year to year in a given locality. I have observed this in collecting areas in Kane, Washington, and Utah Counties, Utah.

At first one is inclined to believe in territories for the breeding populations. However, this does not seem to be the case even though the nesting females appear to be evenly spaced in the habitat. Careful collecting has shown that males, barren females (usually subadult) and juveniles inhabit burrows at irregularly spaces distances making the protection of territories seem quite impossible. Once a nest is established some females do offer resistance to intruders by biting and by digging the burrow deeper.

SEXUAL VARIATIONS: An individual of either sex has a brightly colored and distinct pattern for the first year or year and a half. Juveniles always exhibit a sharp contrast of four light (whitish) stripes separated by three wider stripes. In the older adults with dull colors, the light stripes become faded, tending to blend with the darker stripes which in turn become lighter in color. Thus the sharp contrasting striped condition is less apparent in adults of the Great Basin Skink than in the Western Skink from northern California and Oregon. Specimens from southern California, particularly in San Bernardino and Riverside counties and an occasional specimen throughout the entire range may show the faded pattern. The blending or fading of the color pattern is not restricted to one sex as in some of the subspecies of *Emueces gilberti*.

Except for the reddish color developed by the males during the mating season there is no other external secondary sex characteristic which will aid in an accurate determination of the sexes. in most genera there are postanal scales or tails with the base enlarged in male animals. This is not true in this skink, in fact the tails and their scale patterns are so alike that I have been forced to dissect to be accurate.

Age Variations. There are at least three age groups which can be recognized in a population. These are perhaps best seen in the spring at which time the following groups are readily recognized in a local population.

TABLE 3

The number of eggs observed in eight clutches of the Great Basin Skink.

Date Collected	Number of Eggs	Maximum Size	Minimum Size	Type of Nest	Date Hatched
3 Aug. 1939	4			Natural	
3 Aug. 1939	4	16x10 mm.	15x9 mm.	Natural	10 Aug. 1939
3 Aug. 1939	4			Natural	
3 Aug. 1939	4			Natural	13 Aug. 1939
4 Aug. 1939	2			Natural	8 Aug. 1939
21 Aug. 1955	5	18x10 mm.	16x9 mm.	Natural	26 Aug. 1955
23 Aug. 1955	5			Natural	25 Aug. 1955
11 July 1957	4	14.6x7.3 mm.	12.8x7.9 mm.	Captivity	

Age Group one: The hatchlings of last August, these are approximately 35-45 mm. snout to vent. The tails are bright blue and the striped body pattern is very distinct.

Age Group two: Yearlings past, these range from 48 to 55 mm. snout to vent, and have the pattern of group one.

Age Group three: Adults, two years old and older, these are from 56 to 70 mm. snout to vent. These are the breeding adults, although there is evidence that many of the males in group two may breed. In this group the tail may be olive to gray or perhaps bluish-green and the dorsal striped pattern is faded, sometimes to the point of obscurity.

The gravid female (BYU 12652) taken on July 2, 1955, and discussed above, was only 56 mm. in snout to vent length. Although there are no field data available, the size of the individuals seem to indicate that a few of the larger females may also mate the second spring, and attain to a snout to vent length of 55 or 60 mm. by the time the eggs are layed. Other females taken during the nesting season either with eggs or newly hatched young, have ranged between 58 to 66 mm. in snout to vent lengths. A series of twenty-one males taken from nesting areas, range from 53-66 and average 60.0 mm. in snout to vent length. Thirty-four females from the same area range from 55-77 and average 63.8 mm.

In general these data colaborate the findings of Rogers and Mennmler (*op. cit.*), and Rogers and Fitch (*op. cit.*) in their studies of age groups in this skink in California. Studies of growth and of age groups are best done on a local population over a period of several years. Preserved specimens taken from many localities, at different times of the year, for many years will provide an age group picture not appreciably different than the one given by Taylor (*loc. cit.*), and for these reasons: First, the difference in elevation and slope exposure will indicate differences in which those populations at 4500 to 5,000 feet will have the hatchlings abroad 10 days to two weeks in advance of those above 6,000 feet. The latter would also be forced into hibernation earlier and would thus be smaller in May than those at lower elevations. Second, some seasons are much earlier providing not only an opportunity for more growth in young ones, but also in providing for earlier hatchlings. Third, the wide distribution of this species from Baja California north of British Columbia and east into the Great Basin provides a terrain so deversified and varied as to climate and seasons that one could not expect to have uniformity of growth in a series taken from such a wide area.

Hatchlings taken on the same date in May, after the first hibernation, but at different years have averaged as much as five mm., more or less, in snout to vent lengths. This is also true as regards

elevation. It is perhaps true also of populations separated by a hundred or more miles in which one has been effected by adverse weather such as an early fall, late spring, or a drought. Factors which interfere with feeding, particularly in hatchlings, retards their growth.

Thus, if series from different localities are analyzed as a unit more age groups are seemingly present than actually exist in a single population.

Growth, as in other reptilian forms is seemingly continuous, although the rate is irregular and much reduced, after the individual attains a snout-vent length of 60 mm. Reliable data are not available to indicate longevity in this species.

Predators and Parasites

There are few recorded instances of predation in this species. Zweifel (*loc. cit.*) found skinks in two of eight rattlesnakes (*Crotalus viridis caliginis*) examined from South Coronado Island. Tanner (*loc. cit.*) removed four hatchlings from a small garter snake (*Thamnophis elegans vagrans*) in western Utah County, Utah. Although there are many other probable predators in the habitats occupied by skinks, actual predation has not been recorded.

On the basis of predation in other species of *Eumeces* (Fitch 1954 and 1955) one might also expect these skinks to be the pray of certain hawks, mammals and other snakes. Of the several species of hawks seen in the habitat of the Great Basin Skink none are known to be its predators, although all are known to prey upon reptiles. Bulletins referring to the diet of these hawks list all species of lizards and snakes merely as reptiles. I have examined the nests of several hawks (red-tailed and swainsons) without finding evidence of skink predation, although three species of snakes have been identified. In Utah, such snakes as: *Crotalus v. lutosus*, *Hypsiglena t. deserticola*, *Lampropeltis d. taylori*, and *Diadophis r. regalis* have been taken in the same habitat as these skinks and may include skinks in their diet.

Some evidence of attempted predation is apparent in several large series, in which from five to ten percent of the individuals possess either body scars or regenerated tails.

Little is known concerning the kinds of parasites that infest this skink, or their importance in its ecology. In the many parasitalogical studies including hosts of the western United States, I have not found a single reference to parasitism in *Eumeces skiltonianus*. I have not attempted to investigate the internal parasites although some round worms have been seen while examining stomach contents. The following ectoparasites have been identified by my colleague Dr. Dorald M. Allred.

April 27, 1955, ten specimens taken 29.5 miles east of Red Bluff, along Highway 36, Tahama Co., California, were infested with: one numph, *Ixodes pacificus* Cooley and Kohls; seven fully engorged

larvae, 5 slightly engorged larvae and 2 unengorged larvae. The larvae belong to the genus *Ixodes* and are presumably of the species listed above.

August 16, 1955, two of eight specimens taken in the south fork of West canyon, northwestern Utah Co., each were infested by single larval specimens of the chiggar mite *Trombicula belkini* Gould.

August 22, 1955, one of two specimens taken near the forest camp grounds, Pine Valley, Washington Co. Utah, was infested by a single larval chiggar mite also *Tromicula* belkini Gould.

August 23, 1955, two of ten specimens taken 4 miles north of Glendale, Kane Co., Utah, also had a single larvae of the above listed chigger mite.

In each instance the ticks and mites were attached to the exposed skin between the granular scales in the axilla or around the base of the hind legs. Perhaps the smooth tightly fitting body scales prevents body attacks and reduces generally the ectoparasites in this species.

A survey of the data available indicates that the Great Basin Skink is not heavily infested at any time but with some occurring during the late summer, primarily during August. Utah specimens examined during May, June, and July were not ectoparasitized.

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MITES FOUND ON MICE OF THE GENUS *PEROMYSCUS* IN UTAH. V. TROMBICULIDAE AND MISCELLANEOUS FAMILIES[1]

Dorald M. Allred[2]

This is the fifth and final paper of a series dealing with mites found on five species of deer mice over a five-year period in Utah. Subsequent to the completion and prior to the publication of this study, Brennan and Beck (1957) published on the chiggers of Utah. Because of the relative completeness of their report, this paper has been condensed considerably to avoid repetition of some of their data.

Many of the species of chiggers and mites of other miscellaneous families listed herein were found in so few numbers that only their host relationships, and in a few cases geographic distribution, are given. One species of Trombiculidae is described as new.

Shunsennia ochotona (Radford), 1942

Radford described *S. ochotona* from larvae taken from a pika from Montana. According to Brennan (correspondence) the mites of this study in Utah are strongly aberrant forms or perhaps represent an undescribed species. Jameson (correspondence) designated them as "probably *S. ochotona*." Mites collected from *Peromyscus maniculatus* and *Clethrionomys californicus* in California are similar in many respects to these mites from Utah. Comparisons with a redescription of *S. ochotona* by Radford (1946) revealed differences between some structures, such as the five-pronged tibial claw of the Utah mites (fig. 1). The posterior border of the scutum is rounded, not angular, and the scutal setae and sensillae are shorter than Radford's measurements (fig. 2). Nine of sixteen specimens examined in this study have three setae on both coxae II (fig. 3), one has two setae on both coxae II, and six have three setae on one side and two setae on the other. Two mites have three setae on both coxae III (fig. 3), three have four setae on both coxae III, nine have three setae on one side and four setae on the other, one has three setae on one side and five on the other, and one has four setae on one side and five on the other. The setae between coxae II and III are few in number, usually six in a 2:4 or 2:2:2 arrangement. Thirteen mites haxe six setae arranged in a 2:4 sequence, one has six setae in a 2:2:2 sequence (fig. 3), one has five setae in a 2:3 sequence, and one has seven setae in an irregular 1:6 sequence. The genualae II, tibialae III and spurs are missing in some specimens but are present on one side only in others. Jameson (correspondence) remarked that chiggers belonging to *S. ochotona* are highly variable. Further collections and studies may necessitate a redescription of this species in order to include the extreme variations.

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1. A portion of a dissertation submitted to the University of Utah in partial fulfillment for the Doctor of Philosophy degree

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The sixteen larvae were collected from four female mice fifteen miles west of Fillmore, Millard County, at an elevation of 4900 feet in the Upper Sonoran Life-zone. The numbers of mites found on each of the host animals were seven, two, one and six, respectively. The hosts of these mites were collected during July in a flat, lava-rock, cinder cone area where sagebrush and lava flows were abundant. Mites of the species *Eubrachylaelaps debilis* were the only associates of *S. ochotona.*

Trombicula (*Neotrombicula*) *californica* Ewing, 1942

Ewing named this species from mites collected from pocket gophers, meadow mice and woodrats from California. Brennan and Wharton (1950) stated that this species is extremely variable in all localities where it is known to occur. Some of the following characters in specimens from Utah show some variance when compared with others of this species. In four mites the mastifemoralae are without minute basal barbs, and the femural setae of the palps are nude. The galeal setae are nude on two specimens and branched on another. One mite has a nude galeal seta on one side and a one-branched seta on the other. The dorsal setal formula varies on four mites as follows: 2-11-14-15-9-6-2, 2-9-13-13-10-6-2, 2-15-14-16-10-6-2, 2-11-17-17-9-6-2. The Standard Data (scutal measurements) for the four specimens are as follows:

AW	PW	SB	ASB	PSB	AP	AM	AL	PL	S
84	111	34	41	34	34	48	51	58	65
84	106	31	38	33	34	55	51	62	69
84	106	33	38	31	31	51	55	55	82
89	113	34	43	34	34	55	51	58	—

Ewing (1942) and Brennan and Wharton (1950) reported this species from lagomorphs and rodents including *Peromyscus maniculatus.* This species has been collected in California, Montana, and Idaho. In this study, the four larvae were taken from a mouse at Lake Blanche, Salt Lake County, at an elevation of 9000 feet in the Canadian Life-zone.

Trombicula (*Neotrombicula*) *harperi* Ewing, 1928

This species was described from mites collected from *Napeozapus insignis* from New York. A total of 93 larvae was collected from six male and five female *P. maniculatus* during August. The areas of collection were in the Canadian Life-zone east of Mt. Pleasant at elevations between 7500 and 10,000 feet. Infested mice had an average of 8.4 mites per mouse, and male and female mice were about equally infested. One female mouse was infested with 22 chiggers of this species, while another female mouse had only two mites. It is of interest to note that these mites were not found on any other of the hundreds of *P. maniculatus* collected in similar areas over the state.

Five of the eleven times that it was collected, *T. harperi* was the only species found on its hosts. At other times it was associated with

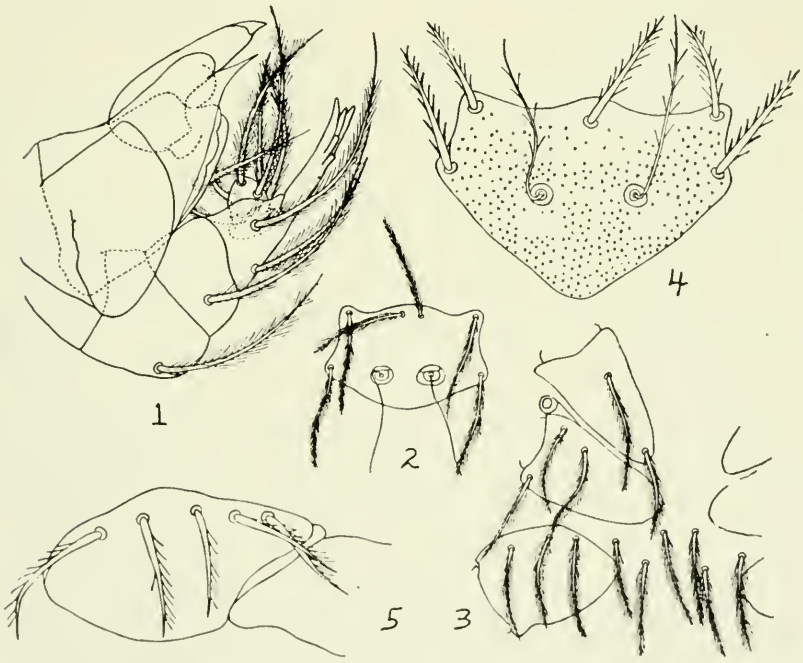
the following species the numbers of times indicated: *Haemolaelaps glasgowi*, 4; *Euhaemogamasus ambulans*, 2; *Eulaelaps* sp., 2; *Parasitidae* sp., 1; Ascaidae sp., 1.

Trombicula (*Trombicula*) *reesi*, n. sp.

Body.—The length and width of the idiosoma of five engorged paratypes vary from 470 to 558 microns by 294 to 470 microns. The engorged holotype is 573 by 426 microns.

Gnathosoma.—The cheliceral bases are punctate, and the cheliceral blades have tricuspid caps. All the palpal setae are branched. The palpal claw is trifurcate, composed of a large axial prong and two smaller accessory prongs. The galeal setae are plumose with about four or five barbs. On one paratype, one of the gaeal setae is two-branched and the other is four-branched.

Scutum.—The scutum is pentangulate (fig. 4). It has punctae which are about equally distributed over the entire surface of the plate except along the anterior edge and immediately posterior to the sensillary bases. The sensillae are barbed along their entire length, but the basal barbs are shortest. The sensillary bases are situ-



(LIST OF FIGURES)

Shunsennia ochotona: fig. 1, dorsal view of right half of gnathosoma of larva; fig. 2, scutum of larva; fig. 3, right coxae and ventral setae of larva.

Trombicula reesi: fig. 4, scutum of larva; fig. 5, left coxa III of larva.

ated slightly posterior to the posterolateral setae. The scutal setae are moderately barbed. The scutal measurements of the holotype are: AW-68, PW-77, SB-27, ASB-29, PSB-30, AP-17, AM-37, AL-31, PL-41, S-58. The same measurements for one paratype are: AW-68, PW-80, SB-29, ASB-29, PSB-29, AP-17, AM-37, AL-34, PL-41, S-58.

Legs.—Leg I: coxa, trochanter and basifemur each with a plumose seta; telofemur with five plumose setae; genu with four plumose setae, three genualae and a microgenuala; tibia with eight plumose setae, two tibialae and a microtibiala; tarsus with about eighteen plumose setae, a spur, a microspur, a parasubterminala, a subterminala and a pretarsala. Leg II: coxa and trochanter each with a plumose seta; basifemur with two plumose setae; telofemur with four plumose setae; genu with three plumose setae and a genuala; tibia with six plumose setae and two tibialae; tarsus with about fourteen plumose setae, a spur, a microspur and a pretarsala. Leg III: each coxa of the holotype with five plumose setae (fig. 5). On four paratypes examined, the setae of the left and right coxae, respectively, are four and five, six and three, five and five, and six and five. The trochanter has a plumose seta, the basifemur two plumose setae, the telofemur three plumose setae, the genu three plumose setae and a genuala, the tibia six plumose seta and a tibiala, and the tarsus about twelve plumose setae and a mastitarsala.

Idiosomal Setae.—The dorsal setae, which number about 105, are irregularly placed and not in discernable rows. The ventral setae number about 100.

Type Data.—The larval holotype and nine larval paratypes were collected from a mouse of the species *Peromyscus maniculatus* at Lake Blanche, Salt Lake County, Utah by Larry Chatwin during the autumn of 1952. This area is at an elevation of about 9000 feet in the Canadian Life-zone. The holotype and several paratypes are in the collection of the author. Other paratypes are deposited at the University of Utah, Rocky Mountain Laboratory, and United States National Museum.

Discussion.—*Trombicula reesi* is related to *T. cynos*, *T. scottae*, *T. sargenti* and *T. jonesae*. It can be readily distinguished from these related species on the basis of the greater number of body setae and the number of setae on coxae III. *T. reesi* is named after Dr. Don M. Rees, Chairman of the Division of Biology, University of Utah.

Euschöngastia criceticola Brennan, 1948

This species was described from three larvae taken from *Peromyscus maniculatus* from Montana during 1946. It is generally statewide in its distribution in Utah, and has been collected at elevations between 2250 and 7000 feet in all of the life zones from the Lower Sonoran to the Canadian, most frequently in the Upper Sonoran.

These mites were collected every month of the year except July, September, October and November. The greatest numbers were taken during January and August.

Eleven of the 21 times it was collected, this species was the only mite found infesting its host. At other times it was associated with the following species the numbers of times indicated: *Eubrachylaelaps debilis*, 2; *E. circularis*, 1; *Hirstionyssus* spp., 7; *Haemolaelaps glasgowi*, 5; *Euschongastia* sp., 1; Laelaptidae sp., 1.

Euschöngastia sciuricola (Ewing), 1925

Ewing described this species from several chiggers taken from squirrels of the species *Sciurus hudsonicus* from Montana. In this study, seven larvae were collected in July from three *Peromyscus maniculatus* at Mercur, Tooele County, and at Steep Creek, 12 miles north of Boulder, Garfield County, at elevations of approximately 6700 and 9000 feet in the Upper Sonoran and Transition life zones.

Collection records indicate that these mites usually are associated with squirrels. Since these collections were made in areas where squirrels of the genus *Citellus* were common, it is likely that these were accidental infestations.

MITE-HOST RELATIONSHIPS

Following is a check-list and host correlation of all mites taken from specimens of *Peromyscus* during this study. In the family and generic names are included some undescribed species and immature forms which cannot be identified past the family or generic level at the present time. Collection localities have been included only for those genera and species which have not been discussed in previous papers.

Mite Species	Total Mites From Each Species of *Peromyscus*				
	boylii	*crinitus*	*eremicus*	*maniculatus*	*truei*
Allodermanyssus sp. Toquerville, Washington County			2		
Antennoporidae sp.				1	
Ascaidae sp.				4	
Brevisterna utahensis		4	2	1	
Bryobia praetiosa Heugh's Canyon, Salt Lake County	1				
Camisiidae sp.				1	
Cheyletidae sp.				2	
Dermanyssus becki	1	12	43	4	
Dermanyssidae spp.		2	3	20	4
Eremaeidae sp.				2	
Eubrachylaelaps circularis	145	35	65	79	68
Eubrachylaelaps debilis		2	2	623	10
Eubrachylaelaps hollisteri		57	70	17	3
Euhaemogamasus ambulans				18	
Euhaemogamasus barberi				1	
Euhaemogamasus oudemansi			1	5	
Euhaemogamasus sp. Provo Canyon, Utah County				1	
Eulaelaps spp. Salt Lake, Utah, Sanpete and Iron Counties				10	

Mite Species	Total Mites From Each Species of *Peromyscus*				
	boylii	*crinitus*	*eremicus*	*maniculatus*	*truei*
Euschöngastia criceticola Statewide distribution	8		12	157	
Euschöngastia sciuricola Mercur, Tooele County; Steep Creek, Garfield County				7	
Euschöngastia sp. Washington, Boxelder, Salt Lake, Utah and Wayne Counties			4	12	
Gamasolaelaptidae sp.				5	
Garmania spp. Utah, Garfield, and San Juan Counties				9	
Glycyphagus sp. Heugh's Canyon, Salt Lake County				1	
Haemogamasus alaskensis				1	
Haemogamasus sp. Parleys Canyon, Salt Lake County				1	
Haemolaelaps glasgowi	48	1	36	1158	10
Haemolaelaps megaventralis				11	14
Hermannia sp. Heugh's Canyon, Salt Lake County	1				
Hirstionyssus femuralis			1		
Hirstionyssus geomydis				2	
Hirstionyssus hilli			7	2	
Hirstionyssus incomptus		2		5	
Hirstionyssus isabellinus				1	
Hirstionyssus obsoletus				1	
Hirstionyssus occidentalis		6	1	409	
Hirstionyssus sp. Wasatch, Garfield, Washington and San Juan Counties				6	
Hypoaspis gurabensis				4	
Hypoaspis leviculus				2	
Hypoaspis spp. Millard, Salt Lake, Summit and Utah Counties		2		5	
Ischyropoda armatus				27	2
Laelaps multispinosus				1	
Laelaps nuttalli				1	
Laelaptidae spp.	2		6	12	
Listrophorus sp. Salt Lake and Garfield Counties				11	
Neoparasitidae sp.				1	
Ornithonyssus bacoti	1	1	2	61	11
Ornithonyssus sp. Upper Sonoran Life Zone areas	2	4	7	41	8
Pachylaelaptidae sp.				2	
Parasitidae sp.		1		30	
Phytoseiidae spp.				5	
Poecilochirus sp. Duchesne Ridge, Summit County				1	
Pymotidae sp.				1	

Mite Species	Total Mites From Each Species of *Peromyscus* *boylii*	*crinitus*	*eremicus*	*maniculatus*	*truei*
Radfordia lemnina Steep Creek, Garfield County				1	
Radfordia subuliger Chimney Rock Pass and Lehi, Utah County				2	
Rhizoglyphus echinopus Lehi, Utah County				1	
Shunsennia ochotona Fillmore, Millard County				16	
Tetranychidae sp.				1	
Trombicula belkini Fish Springs, Juab County					1
Trombicula californica Lake Blanche, Salt Lake County				4	
Trombicula harperi Mt. Pleasant, Sanpete County				93	
Trombicula jewetti Roosevelt, Duchesne County				1	
Trombicula microti Parowan, Iron County				1	
Trombicula montanensis Rich, Sanpete and Kane Counties				21	1
Trombicula myotis Bridgeport, Daggett County				1	
Trombicula reesi Lake Blanche, Salt Lake County				10	
Trombicula sp. Weber, Salt Lake and Beaver Counties				7	
Trombiculidae spp.	4	7		13	
Typhlodromus mariposus				17	
Uropodidae sp.				6	

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A NEW GENERIC NAME FOR AND SOME BIOLOGICAL DATA ON AN UNUSUAL CENTRAL AMERICAN BEETLE (COLEOPTERA: PLATYPODIDAE)

Stephen L. Wood[1]

It was shown by Laboisiére (1940, Exploration du Parc National Albert, Mission G. F. de Witte, fasc. 31:51) that the generic name *Chapuisia* Dugés (1886, Ann. soc. ent. Belgique 29(2):58), of the family Platypodidae, is a junior homonym of *Chapuisia* Duvivier (1885, Mem. soc. sci. Liége, serie 2, 11(15):57) of the family Chrysomelidae. Since no other name is available for this unique platypodid genus, the new name *Schedlarius*, with *Chapuisia mexicana* Dugés as the type and only known species, is proposed in honor of Dr. K. E. Schedl who has contributed so much to our knowledge of the Scolytoidea.

This species, to be known henceforth as *Schedlarius mexicanus* (Dugés), is of considerable interest morphologically and biologically because of its unique position in the Scolytoidea. The taxonomic rank assigned to the group it represents has varied from author to author, ranging from that of tribe to family. The unusual morphological characters of this beetle are associated with equally unusual habits that until now have remained almost unknown.

Examples of this species were collected by the writer while with the 1953 expedition of the Francis Huntington Snow Entomological Museum (University of Kansas), three miles northwest of Tequila, Jalisco, Mexico, on July 19, at an elevation of 4000 feet, in a semi-desert area, from a broken limb eight inches in diameter of a small isolated tree that has not yet been identified. In general, the entrance tunnel penetrated the bark and about six to nine millimeters into the wood. At this point one to five egg galleries branched off and followed the grain of the wood parallel to the central axis of the limb. The egg galleries were more or less irregular in diameter and direction, and were as much as 10.5 centimeters in length. Although the wood surrounding the gallery systems was usually discolored slightly by the presence of fungi, as with some *Rhyncolus* galleries, there was no evidence whatsoever of an ambrosial fungus growing on the gallery walls, either with a magnification of 20 diameters at the time the collection was orginally made, or at 80 diameters two weeks later.

The eggs were deposited individually in rather large niches that were apparently placed indiscriminately around the walls of the egg gallery, with no evident preference for or against any particular position. Each egg was packed in its niche with a mixture of boring dust and a substance presumed to be a salivary secretion of the female parent. The larvae tunneled directly across the grain of the wood perpendicular to the axis of the egg gallery. Each larval tunnel curved gradually either to the right or left, and extended not more

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Scolytoidea Contribution No. 13

than one centimeter from the egg gallery. Most of the larvae were in the first or second instar, a few were in the third, and one larva was in the fourth instar. Pupae were not present.

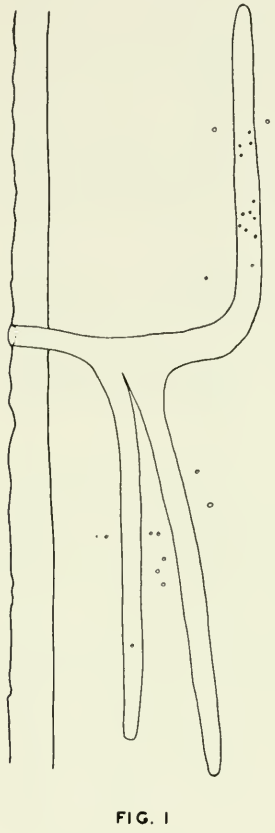

FIG. 1

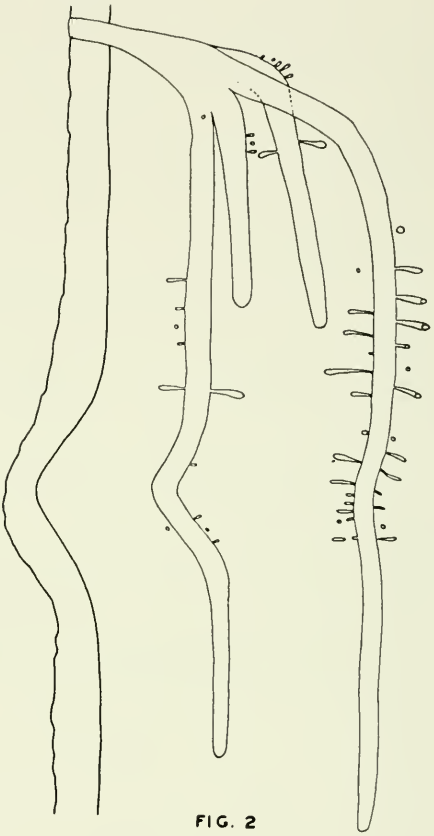

FIG. 2

Figs. 1-2. Galleries of *Schedlarius mexicanus:* 1. illustrates position of egg niches in upper gallery; 2, includes tunnels of larva.

NEW SPECIES OF BARK BEETLES (COLEOPTERA: SCOLYTIDAE), MOSTLY MEXICAN. PART IV

Stephen L. Wood[1]

In this paper three new species of scolytid beetles are described as new, two in the genus *Cactopinus* Schwarz, from Mexico, and one in *Pseudothysanoes* Blackman, from Florida. The two former species were collected by the writer while with the 1953 expedition of the Francis Huntington Snow Entomological Museum (University of Kansas, Lawrence), the latter species was received from Dr. A. N. Tissot (University of Florida, Gainesville) through the U. S. National Museum.

The genus *Cactopinus* is of special interest because the peculiar modification of the male frons, along with other characters, has led various authors (Chamberlin, 1939, the Bark and Timber Beetles of North America, p. 242) to elevate the group to the rank of subfamily. However, since that action was taken, many new species and genera have been added to the family; and it is now possible to assign *Cactopinus* to the tribe Micracini, evidently near the genera *Phloeoclyptus* Wood and *Stenoclyptus* Blackman.

Cactopinus cactophthorus, n. sp.
Figs. 1, 4, 5, 6

This species differs from previously described species by the presence of a sharp tubercle at lateral margin of frons between antennal insertion and eye, by the much smaller posterior elevation of pronotum, and by the smaller size.

Male: Length 1.37 mm., 2.41 times as long as wide; color black.

Frons with a deep, subconcave transverse impression extending from vertex to epistoma, the upper margin abrupt but not sharp; epistoma bearing a pair of contiguous hornlike processes, about 0.24 mm. long (variable in the series), as in other species of the genus, with a pair of conspicious bristles near tip; vestiture limited to an epistomal brush largely concealing mandibles, rather long hairlike setae ornamenting the hornlike processes, and a row of setae along upper margin of concavity. Eye short, ovate; finely granulate. Antennal scape short, bearing several setae; funicle five-segmented, club subcircular, with three transverse sutures indicated by setae (Fig. 4).

Pronotum about 1.1 times as long as wide; widest near middle, posterior angles rather broadly rounded, sides weakly arcuate; anterior margin rather narrowly rounded and armed by about four small teeth; the indefinite summit just in front of posterior margin, the posterior elevation not extending beyond the margin; asperities small and blunt, sharper and more abundant in anterior area than in previously described species; vestiture consisting of a few scattered, slender hairs.

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Elytra 1.37 times as long as wide, about 1.3 times as long as pronotum; sides subparallel on anterior three-fourths, rather broadly rounded behind; striae not impressed except the first near declivity, punctures large, deep, close; interstriae about one-half as wide as striae, finely punctured, irregular, one, two, and three finely, uniseriately granulate, one, five, and seven evidently also bearing minute granules (granules on two and three show on Fig. 1). Declivity steep, strongly sulcate between third interstriae, as wide as, and much deeper than in *koebelei;* first interstriae weakly elevated, bearing a row of fine granules; first striae impressed, deeply punctured, others obscure; lateral convexities rather high, with fine granules on all of the interstriae but the tenth, those of the second somewhat larger, interstriae two and three both forming the crest of the elevations. Vestiture consisting mostly of small, short, yellow hairs, and a few longer yellow bristles along sides.

Female: Frons less strongly impressed, epistomal processes absent, and declivity less strongly sulcate, otherwise similar to male.

Type Locality: Ten miles southeast of Tehuitzingo, Puebla, Mexico.

Host: Giant Cactus.

Type Material: Male holotype, female allotype, and 139 paratypes were collected July 3, 1953, by the writer, from just beneath the outer surface of the drier parts of a standing, treelike, dying, giant cactus having eight longitudinal ridges on each branch. The holotype, allotype and some paratypes are in the Snow Entomological Collections, other paratypes are in the collection of the writer.

Definite gallery patterns could not be determined. They were, however, filled with frass even where the beetles were working; the presence of a specimen usually being determined by the movement of this material. The beetles moved through their frass filled tunnels with remarkable speed, progressing with the leading parts of the head near the bottom of the tunnel, the frass then being forced up over the back and to the sides of the specimen, leaving a firm footing beneath. The frontal horn of the male appeared to serve as a tactile organ enabling him to move with greater speed and efficiency of movement than the females. The stout setae on the male horn and on other parts of the body were not bent by the frass in the tunnels as would be the case with the usual types of scolytid setae. These observations were made in the laboratory at magnifications up to 80 diameters.

Cactopinus spinatus, n. sp.
Figs. 2, 3, 7

Perhaps more closely allied to the foregoing species than to others of the genus. Distinguished from all others in the genus by the rather long tuberculate lateral processes on frons, by the pair of median epistomal tubercles in the male, by the alternately tuberculate interstriae, by the much deeper and wider declivital excavation and the much larger declivital teeth.

Male: Length 1.6-1.7 mm., 2.52 times as long as wide; color black.

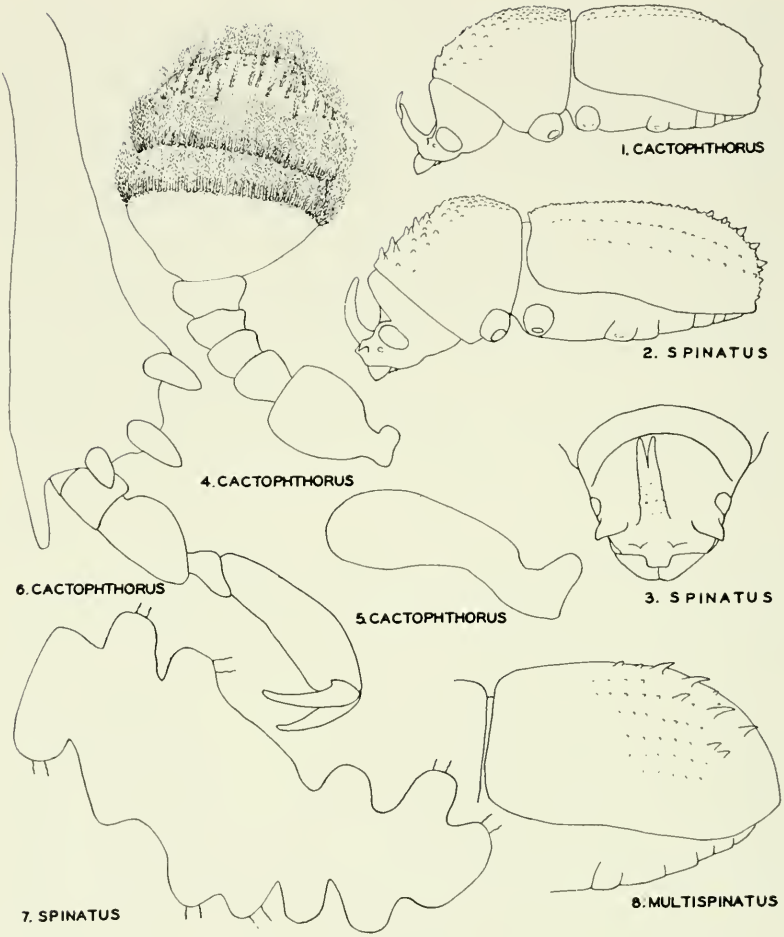
Frons (Fig. 3) with a deep, subconcave impression extending from vertex to epistomal margin; the arcuate upper margin sharply elevated almost from eye to eye, concavity with rather large, shallow, inconspicuous punctures of moderate abundance on lower half, smooth, but not shining above; a rather short, broad, median epistomal process largely concealed by a rather narrow epistomal brush, and just above ends of brush a pair of sharp, broad tubercles, and above and between these tubercles the large, curved epistomal horn; the halves of epistomal horn fused except at tip, finely tuberculate, and clothed with a few short hairs; a large elevated, transverse process extending laterally from just below the horn to just above the antennal insertion; vestiture consisting of the epistomal brush and a row of sparse, short, yellow hair along upper margin of concavity. Eye short, oval, about one and one-half times as long as wide. Antennal scape perhaps a little longer than other species of genus and bearing several long setae; club small, oval, not strongly compressed.

Pronotum about as wide as long, subcircular in outline; anterior margin rather narrowly rounded and armed by about six rather large submarginal teeth; asperities rather large and sharp anteriorly, summit just in front of posterior margin, posterior elevation poorly developed, not reaching margin; surface finely granulate, with a few larger granules laterally in posterior one-fourth, posteromedian asperities slender, higher than wide, abundant; vestiture consisting of very long, coarse, curved hair.

Elytra 1.57 times as long as wide; sides subparallel on basal three-fourth, almost truncate behind; striae not impressed except first posteriorly, the punctures rather large, deep, close; interstriae about one-half as wide as striae, the first, third and fifth distinctly elevated from just behind scutellum to apex; interstriae one, three, five, seven and posterior one-third of two uniserially tuberculate, tubercles isolated, high, rather sharp (only three, five and seven show on Fig. 2, except for the large declivital teeth of two). Declivity very strongly, broadly sulcate, very steep; suture slightly elevated lateral elevations high, the crest armed on inner margin of summit by five large, sharply pointed teeth from the second interstriae, and the outer margin by several smaller teeth from the third interstriae; declivital face finely granulate and irregularly punctured (surface obscured). Vestiture consisting of short, erect, yellow strial and interstrial hairs, and very long, coarse bristles on interstriae three, five, seven, and along sides; vestiture on declivity consisting of a single row of short setae along suture. First and second abdominal segments each almost as long as three, four and five combined.

Female: Frons less strongly impressed, epistomal horn absent, other frontal tubercles present, but smaller; declivity with the teeth of second interstriae usually reduced in number.

Type Locality: One mile southeast of Camaron, Oaxaca, Mexico.



Figs. 1, 4-6. *Cactopinus cactophthorus*: 1, lateral aspect of male; 4, anterior face of antennal club and funicle of male; 5, antennal scape of male; 6, posterior face of fore tibiae and tarsus of male (same scale as 4 and 5).

Figs. 2, 3, 7. *Cactopinus spinatus*: 2, lateral aspect of male (same scale as 1); 3, cephalic aspect of head of male; 7, parental gallery with beginnings of seven larval galleries indicated.

Fig. 8. *Pseudothysanoes multispinatus*, lateral aspect of male elytra (same scale as 1 and 2.

Host: Unknown tree.

Type Material: Male holotype, female allotype, and 49 paratypes were collected July 7, 1953, by the author, from the cambium region of dying twigs of a large nut bearing tree that had pinnately compound leaves. The holotype, allotype and some paratypes are in

the Snow Entomological Collections, other paratypes are in the collection of the writer.

The beetles appeared to be monogamous. They constructed short, broad transverse galleries in the cambium region about 5 to 8 mm. long and about 2 mm. wide (Fig. 7). The walls of these frass filled egg chambers were completely lined by large egg niches wide enough and deep enough to accomodate the head and thorax of the female parent. One larval tunnel arose from each niche and ran parallel to the grain of the wood, engraving both wood and bark, and were from 2 to 5 cm. in length. The pupal chambers were somewhat enlarged and engraved the wood more deeply; these were followed by large, irregular feeding tunnels.

Pseudothysanoes multispinatus, n. sp.
Fig. 8

This species is intermediate between *bartoni* Bruck, from California, and *spinatus* Wood, from Mexico. In addition to differences in male declivital armature, both sexes of this species are larger, more coarsely sculptured on head, pronotum and elytra, and have the frons much more strongly impressed than in either *bartoni* or *spinatus*.

Male: Length 1.3 mm., 2.2 times as long as wide; body color brown.

Frons subconcave almost from eye to eye from epistomal margin to well above eyes, an additional subfoveate, smooth median sulcus at bottom of concavity; surface covered by rather coarse craterlike granulate punctures; vestiture consisting of sparse, short, coarse hair. Eye ovate, entire; finely granulate. Antennal club ovate; sutures scarcely visible, strongly arcuate, the first almost one-half the length of the club from the base, the second more than three-fourths the length from the base.

Pronotum 0.92 times as long as wide; widest near base, sides arcuately converging toward the rather narrowly rounded anterior margin; anterior margin armed by four rather large closely set teeth; general surface smooth and moderately shining with rather close, coarse, low craterlike granulate punctures; vestiture consisting of short, slender scales and hairs, longer near summit.

Elytra 1.4 times as long as wide; sides straight and subparallel on basal two-thirds, rather broadly rounded behind; striae slightly impressed toward declivity, the punctures rather large, very close, deep; interstriae about as wide as striae, the punctures fine and granulate, some granules forming sharply pointed spines near upper margin of declivity. Declivity (Fig. 8) beginning near middle of elytra, moderately steep; striae and interstriae slightly narrower than on disc, and except for the spines, similarly sculptured; interspace one armed by two long slender spines at upper margin of declivity separated by a distance slightly greater than the length of either spine, one or two smaller spines above and below the large ones; interspace

three with two larger, slender spines, the first just below level of second spine of interspace one, and almost similarly spaced, and with one small spine above the first; interspace five with two rather closely set smaller slender spines, both located at a level between the spines of interspace three. Vestiture scalelike, shorter and about twice as long as wide on disc; longer and about six times as long as wide on declivity.

Female: Similar to male except: very slightly larger, frons rather strongly concave, sutures of antennal club more clearly evident; teeth on anterior margin of pronotum scarcely evident; elytra more finely sculptured; and declivity shorter, more abrupt, and devoid of spines.

Type Locality: Gainesville, Florida.

Host: Tilia cienoserrata.

Type Material: The male holotype, female allotype and 41 paratypes were collected at the type locality on January 17, 1939, collection number 8870, by A. N. Tissot. The holotype, allotype and some paratypes are in the U.S. National Museum, other paratypes are in the collections of Dr. Tissot and the writer.

A NEW SKINK OF THE MULTIVIRGATUS GROUP FROM CHIHUAHUA

Wilmer W. Tanner[1]

A skink, USNM 30833, taken by the Brimley brothers in Chihuahua, Mexico, has, for lack of a better understanding of its relationships been heretofore associated with the *multivirgatus* complex. Taylor (1935:352) and Smith and Taylor (1950:166) suggested its apparent distinctness but because of a badly faded color pattern hesitated to describe it as new.

In July, 1931, D Elden Beck took a subadult at Colonia Garcia, Chihuahua. In August, 1957, the author secured an adult at Colonia Chuhuichupa, Chihuahua. A study, of these three sepcimens and a comparison of them with *multivirgatus* from Arizona, New Mexico, Utah and Colorado, has demonstrated significant color and scale pattern differences. I, therefore, propose that this new skink be known as

Eumeces multilineatus, n. sp.

Type: Brigham Young University No. 13798, collected by Wilmer W. Tanner and Gerald Robison, 3 miles north of Colonia Chuhuichupa, Chihuahua, Mexico, on August 26, 1957. El. 7500 ft.

Paratypes: Brigham Young University No. 11984, from Colonia Gracia, Chihuahua, Mexico, by D Elden Beck, July 12, 1931; U. S. National Museum No. 30833, from Chihuahua, Mexico, collected by H. H. Brimley and C. S. Brimley.

Diagnosis: A *Eumeces* of the *multivirgatus* group, of similar size, body and limb proportions as in *multivirgatus*. Postnasals absent; frontonasal nearly twice as wide as long; interparietal not enclosed; seventh supralabial separated from ear opening by one pair of enlarged postlabials; median ventral caudals approximately three times as wide as long; color pattern consisting of five primary light lines over a dark ground color; median line on inner third of first scale row, followed laterally by a dark stripe on median third of first scale row. Scales between dorsolateral and lateral light stripes a uniform blackish color.

Description of the type: Rostral normal, in contact with first supralabials, nasals, and internasals; two internasals followed by a frontonasal, nearly twice as wide as long; prefrontals widely sutured; frontal large, only slightly wider anteriorly than posteriorly, the latter part rounded; four supraoculars, second largest; frontoparietals smaller than interparietal, the latter arrowshape; parietals large, nearly in contact with primary temporal, not enclosing interparietal; two pair of muchals of equal size; nasal divided, anterior part slightly larger; anterior loreal higher than long, posterior longer than high, anterior scale in contact with first and second labials, nasal, internasals, frontonasals, prefrontals and

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the posterior loreal; six superciliaries, first much larger; one small preocular, nearly square; two presuboculars, anterior at least four times the larger; two postoculars, lower one largest; postsuboculars smaller than postoculars, upper largest, three on left, two on right side; primary temporal in broad contact with the upper secondary and in narrow contact with the lower secondary temporal, smallest of the three; one elongate tertiary temporal, in contact with postlabial; ear with three lobules; supralabials 7-7, seventh largest and followed by a single large postlabial extending to ear lobules; infralabials 6-6; two single postmentals, posterior one largest.

Scale rows around middle of body 24, dorsal median rows slightly enlarged; dorsals 56; ventrals 40; median row of caudals noticeably enlarged, approximately thirty per cent as long as wide; lamallae fourth toes 12-13; fourth fingers 10-10; total length 165.7 mm. snout to vent 70.0 mm; body into tail 1.37 times; toes of adpressed legs separated by six scales.

Color and color pattern: Ground color above dark brown to nearly black laterally and with a series of seventeen distinct light and dark longitudinal stripes. Median dorsal stripe yellowish-cream, faintly bifercate on head, extending along sutures of interparietal, across frontoparietals, along sutures of frontal and terminating on prefrontals; median stripe occupying the inner third of the two median scale rows; a sharply deliniated dark brown stripe occupies approximately the middle third of each median scale row; lateral third of median scale row and entire second scale row, a medium brown, lateral margins of second row with an occasional darker spot; a creamy-white dorsolateral stripe extending from supraoculars posteriorly and occupying middle third of the third scale row, median and lateral thirds of this row, fourth and most of fifth rows a uniform brownish black; lateral edges of fifth row cream white; medial edges of sixth row blackish (this produces a broken white line for most of the area between the legs); lateral stripe yellowish to light cream, extending from second supralabial caudad on median part of labials, through ear, and onto middle of sixth row, terminating at insertion of hind leg; a lateral dark stripe occupies lateral part of sixth row and adjoining elges of seventh. Ventral scales a bluish-green with fine flecks of darker pigment principally on sides; scales of gular and anal regions with a cast of bronze.

Primary and secondary body stripes distinct for the entire length of the body; with little apparent fading from head to base of tail, becoming indistinct on tail near toes of adpressed hind legs.

Variations: The two specimens (BYU No's. 11984 and 13798) are, except for size, almost duplicates. They show the following variations, when compared with the specimen from the national museum (30833): In the latter the frontonasal is noticeably longer, the per cent of length to width equals .71, whereas in the two it is .54 and .57 respectively. The prefrontals are narrowly separated, as opposed to a broad contact in the others, and there are four

small postlabials between the seventh supralabial and the ear lobules. The color pattern is so badly faded that any differences which may have existed are no longer possible to detect. By wetting the specimen one can see on the neck and shoulder regions the lateral, dorsolateral and median light stripes. For a short space the color pattern on the median scale rows, though faint, appears to be essentially as described for the type. Otherwise the pattern is faded to an almost uniform light brown.

Unfortunately there is no reliable locality data for the faded specimen. It does not seem likely that it came from the same general area as the other two specimens, although even this may be the case.

Habitat: On the basis of the two known localities, the general range of *multilineatus* is to be found in the higher elevations of the Sierra Madre Occidental, and may be associated with habitats in or near the pine forests.

The specimen found at Colonia Garcia was taken from a rotting pine log, not far from a small stream and along the edge of a pine forest (most of which has now been removed). North of Chuhuichupa the type was taken on a steep rocky slope extending up from the river. We had just bagged two large black-tailed rattlers when I saw the skink some 25 feet away coming toward me. Without hesitation it came to within a few feet of my boots, then became startled and took refuge under a small rock. The next day we turned tons of rock without uncovering a skink. One was seen, however, but it too was abroad and too close to some porous ledges to be caught.

Relationships: For several years I have taken every opportunity to examine and record data from all specimens referred to the *multivirgatus* complex.[2] I have, therefore, seen such specimens at the United States National Museum, University of Kansas, and have received on loan material from Dr. Hobart M. Smith, University of Illinois, Dr. Phillip W. Smith, Illinois State Natural History Survey, and Dr. E. R. Hall, University of Kansas.

Recent trips into Arizona have permitted me to see and examine this species alive at all age groups, hatchlings to adults. On the basis of specimens of *multivirgatus* seen from Arizona, New Mexico, Colorado and Utah, the following comparisons are made.

In scalation the two species are similar. In most *Eumeces multivirgatus* a postnasal is present, out of 33 specimens seen, including the type material of *E. gaigei* (KU 7300 and 7301) and *E. taylori* (KU 13161) at the University of Kansas, the postnasals are: 2-2 in one, 1-1 in 24, 1-0 in five and 0-0 in three; one or two postlabials, which are separated from the ear lobules by two or more small scales; the frontonasal is proportionately longer and the median row of subcaudals is less widened transversely.

2. I wish to express my thanks and gratitude to those individuals who have provided me with facilities and permitted me to examine their collections.

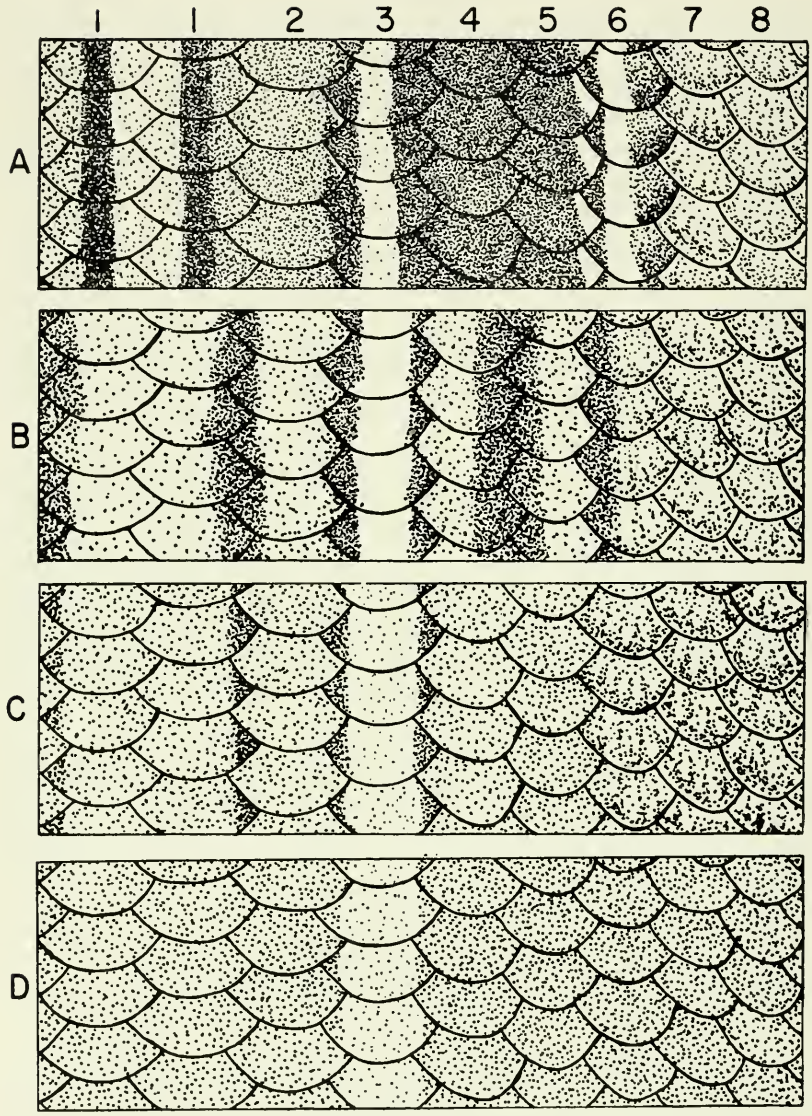

Fig. 1 - Color patterns of the dorsal and right lateral sides of *Eumeces multilineatus* and *Eumeces multivirgatus*. The numbers indicate the longitudinal rows, with the ones representing the dorso-median rows. Snout to vent measurements are included for each specimen. A. *E. multilineatus*, adult ♂, 70 mm., BYU 13798 type, Chihuahua, Mexico. B. *E. multivirgatus*, adult ♀, 63.5 mm., BYU 13242, Coconino Co., Arizona. C. *E. multivirgatus gaigei*, adult ♂, 61.7 mm. INHS 7560, Coconino Co., Arizona. D. *E. multivirgatus taylori*, adult ♀, 64 mm. INHS 6496, Coconino Co., Arizona. For a comparison with *multivirgatus* from Colorado and Utah see Maslin (1957:88).

The color pattern is substantially different in *multilineatus*, though at first appearing to be much the same as that of *multivirgatus*. In general the adult ground color of *multilineatus* is darker, the stripes both primary and secondary are sharply defined from head to base of tail and the forked pattern of the median stripe is faint, but discernable, on the head plates. This is not necessarily true in *multivirgatus* in which adults may be found without stripes and grading to those in which at least the primary stripes are clearly defined. In the latter the head pattern is usually absent or obscure. A few of the significant differences may be observed in fig. I: (a) The median scale rows are each involved in three longitudinal stripes in *multilineatus*, only two stripes in *multivirgatus*. (b) The lighter brown stripe between the black stripes bordering the median and dorsolateral light stripes is approximately one and one-third scales wide, occupying the lateral third of the first scale row and all of the second row. In *multivirgatus* this stripe is usually very narrow, occupying less than one scale row, with the darker stripe bordering the median stripe as wide or wider, occupying approximately the adjoining halves of the first and second rows. (c) In *multilineatus* the space between the dorsolateral and the lateral light stripes (from the lateral third of row three to the edge of row six) is a dark brownish-black, except for the lateral edges of row five which are cream fleck with greenish-blue; *multivirgatus* is extremely variable in this area of the pattern; some specimens have a narrower area with the lateral light stripe on scale row five (See Maslin 1957:88, fig. 1), others have as many as five different shades of brown, giving a faintly striped effect, but with only the borders of the light stripes dark and distinct. (d) Below the lateral light stripe in *multilineatus* is a dark blackish stripe which separates the lateral stripe from the lighter ventrals. The lateral stripe of *multivirgatus* is not always clearly defined probably because the lateral dark stripe is not present to accentuate it.

Remarks: Recent studies (Lowe, 1955; Maslin, 1957; Mecham, 1957; and Heyl and Smith, 1957) have helped in clarifying the taxonomic status of *E. multivirgatus*. The inclusion of *E. gaigei* Taylor and *E. taylori* Smith as parts of the more widespread *multivirgatus* is seemingly justified. Agreement concerning the status of sub-species is not yet complete owing primarily to the incomplete series available. Lowe (*loc. cit.*) and Maslin (*loc. cit.*) would retain both *gaigei* and *taylori* as subspecies, whereas Mechan (*loc. cit.*) would retain only *gaigei* as a subspecies, with *taylori* becoming a color phase of *gaigei*.

The availability of a sizeable series, with a larger number from Arizona than has been previously reported, has provided data which I believe to be significant. The variations in the *multivirgatus* color pattern are nearly all met in a series from Flagstaff, Arizona (Oak Creek Canyon, approximately 12 miles S.W. of Flagstaff, 6 specimens; and 6-7 miles N.E. of Flagstaff 16 specimens.) One adult (ISNHM 7562) shows no distinct stripes as in *taylori;*

some have only the dorsolateral stripes present as in the type of *gaigei;* several have only the median, dorsolateral, and lateral light stripes; and some have the pattern of *multivirgatus.* The hatchlings are much the same as the pattern given by Maslin (1957: 88, fig. 1-E) for a Utah (*gaigei*) juvenile, except that the lateral stripe is on the sixth rather than the fifth row. Out of the twenty adults and subadults from Arizona, one is of the *taylori* color phase, seven are of, or approaching the *gaigei* phase and twelve show the pattern of *multivirgatus.* Those from Oak Creek Canyon are darker and of the *taylori-gaigei* patterns, whereas the more northern populations are of the *gaigei-multivirgatus* patterns.

It is seemingly obvious that the color pattern phases of *multivirgatus*: (a) cannot, for much of the southern and western range, be effectively limited to a single geographical area for each phase; (b) are more varied than is implied by the phases listed above and may include other phases such as the five lined or "*faciatus*" phase; (c) are the products of certain, as yet undetermined, genetical principles which have provided this species with an extremely variable color pattern not often observed and certainly unusual in *Eumeces;* (d) may be more clearly set forth if hatchlings as well as adults are used in determining the basic pattern of the various populations.

The data and conclusions presented by previous studies, and that arising from the material available for this study, has demonstrated the presence of a number of intraspacific color pattern phases in *multivirgatus.* There are, undoubtedly, several of these "color phases" which will warrent subspacific rank when material is available to separate the geographical races. There is perhaps sufficient evidence to retain *E. taylori* as a subspecies. The pattern is distinct and there apparently is an established ecological isolation in western Texas and southeastern New Mexico. The occurrance of a lineless pattern in Arizona, Nebraska and perhaps in other widely separated populations might be expected in a polytypic species.

Maslin (*loc. cit.*) has demonstrated the existance of *gaigei* in southern Colorado and eastern Utah. I have not seen his material, however a specimen from Elk Ridge, San Juan County, Utah has been compared with the types of *gaigei* and is of the same basic pattern. Thus the range of *gaigei* can be, for the present, restricted to northern New Mexico, southern Colorado and eastern Utah. The specimens available from other populations in central New Mexico and Arizona are either of the *gaigei* or *multivirgatus* patterns. Those from Arizona are actually much closer to *multivirgatus* and should, in spite of their separation from other populations, be retained in this subspecies for the present. The present understanding of the species and subspecies in the *multivirgatus* group of skinks is as follows:

Eumeces multilineatus n. sp.
Eumeces multivirgatus multivirgatus (Hallowell)
Eumeses m. gaigei Taylor

Eumeces m. taylori Smith[3]
Eumeces humilis Boulenger
Eumeces parvulus Taylor
Eumeces parviariculalus Taylor

The following natural history notes are also worthy of recording. The two hatchlings, BYU 13886-7, were taken at an elevation of approximately 7,000 feet, August 18, 1957. They were found in a small rock pile in an open area between the Ponderosa Pine. Their snout to vent lengths are 29.1 mm. and 28.2 mm. respectively. In all, three hatchlings were seen, one escaping. Obviously hatching had occurred only a few days previously, providing little time for growth. Compared with the hatchling length listed for the Texas brood (Mecham 1957:114) they are slightly larger. I have noted equal size variation to occur in day old hatchlings of *E. skiltonianus* and would expect the same to be true in this species.

Material: Arizona: Coconino Co., Oak Creek Canyon, (ISNHM 6496, 7559-62, UI 30290); Approximately 6-7 miles NE of Flagstaff (BYU 11552-4, 13240-7, 13883-7). Colorado: Weld Co., 6 miles NW. of Keenburg (KU 16343-8). New Mexico: Taos Co., near Taos (KU 7300-1); Eddy Co., Black River, 2 miles E of entrance of Carlsbad Caverns (KU 13161); Lincoln Co., Ruidoso Creek (USNM 25437). Utah: San Juan Co., Bears Ears, Elk Ridge (BYU 534).

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3. when sufficient material is available, *taylori* Smith may be replaced by either *inornatus* Baird or *epipleurotis* Cope.

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